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THE SUBSTITUTION OF THE ERECTOR SPINÆ FOR PARALYZED GLUTEAL MUSCLES

AN OPERATION FOR STABILIZING THE HIP

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SINCE the description of infantile paralysis by Heine in 1840 the attention of every bone surgeon has been directed toward methods for relief of the permanent paralysis. Innumerable mechanical appliances have been devised and many operative procedures have been described. The earlier surgeons were content with division of contracted tendons to improve deformities, while in later years more effort has been made to stabilize the paralyzed extremity by fixation of joints by means of the arthrodesis operations; by transplantation of tendons and the use of foreign materials, especially silk cord, for artificial tendons. On the whole, these procedures have been very successful in the paralysis of certain groups of muscles, as in the forearm and in the lower extremity below the knee joint. The greatest problem confronting the surgeon is to find a substitute for the permanently paralyzed muscles of the thigh and of the stabilizers of the hip. Gluteal action has been the most difficult to produce. When the gluteus medius is paralyzed, abduction of the extremity is lost. The gait associated with this type of paralysis is quite characteristic, the limp and lameness cannot be relieved by braces, and every apparatus has been wholly unsatisfactory.

When the gluteus maximus is paralyzed and the weight is borne on the affected side, the body is thrown back with a sudden lurch and the patient hurries with the other leg. The gait is like that of a person who has had an amputation of the thigh and is wearing an artificial leg. When the action of both of these muscles has been lost, it is quite evident that no type of brace will suffice to bring about satisfactory action or stabilization of the hip joint. Nothing short of an arthrodesis of the hip joint would enable a patient thus disabled to get about. In those cases in which one or the other of these muscles is intact, a certain degree of success has attended the transplantation of certain living muscles.

Where the gluteus maximus is intact, Lange has substituted the vastus externus for the paralyzed gluteus medius and minimus. The upper attachment of the vastus is detached from the trochanter major and, by a series of silk sutures, is sewed to the crest of the ilium, aiding the abduction power of the leg. Legg devised an operation for cases in which the gluteus medius was paralyzed with impairment or loss of abduction of the leg. He transplanted the tensor fasciæ latæ into the upper portion of the shaft of the femur. Obviously, neither of these operations is applicable in complete paralysis of all the gluteal muscles.

In a complete paralysis of the leg, one finds only the weak adduction action of the iliopsoas

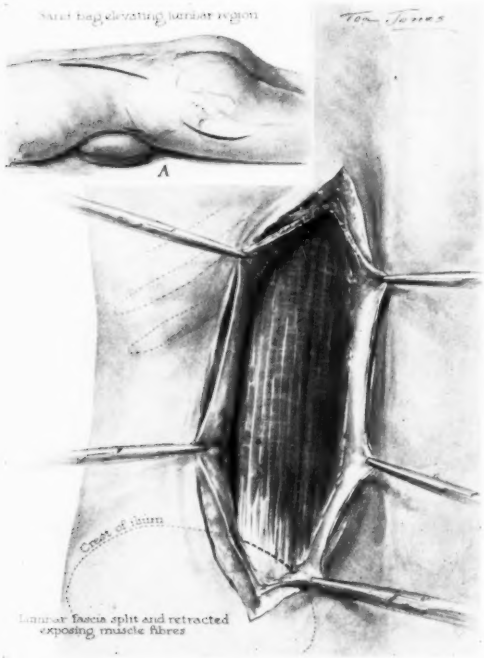

Fig. 1. Exposure of the erector spinæ (sacrospinalis). Dotted line over the muscle indicates the incision through it longitudinally and the line of tendinous detachment from the crest of the ilium. *A*, shows the position of the patient on the operating table in which the lumbar spine is elevated, making the erector spinæ more accessible. Dark lines indicate the skin incisions. (All drawings made from sketches by the artist at the time of operation.)

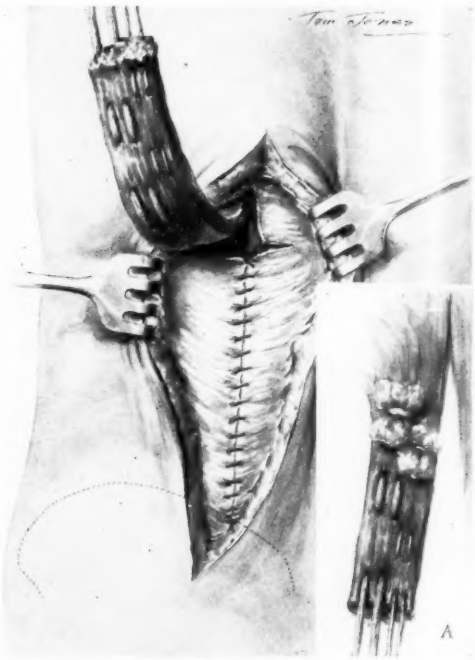

Fig. 2. The portion of the muscle to be utilized has been carefully dissected from its bed and the silk cords quilted into it. The lumbar fascia has been closed. The transverse incision through this fascia is made to avoid constriction of the pedicle. *A*, shows the method of suturing the silk cords into the muscle. Small pads of fat are placed under the end loops to avoid pressure necrosis. Observe that the loops are placed at two different levels and the insertions of each pad of silk cords are on alternating planes so as to interfere as little as possible with the circulation and nerve supply.

attachment to the lesser trochanter. The entire lower extremity is unstable and incapable of carrying any of the body weight or producing any motion except the dragging of the leg inward and slightly forward as the leg dangles from the hip. The patient gets about on crutches, carrying or dragging the paralyzed extremity, or hops about on the unparalyzed leg.

In reviewing the nerve supply of these muscles, we find that the gluteus maximus is supplied by the fifth lumbar and the first and second sacral nerves through the inferior gluteal nerve from the sacral plexus. The gluteus medius and minimus are supplied by the fourth and fifth lumbar and first sacral nerves through the superior gluteal. The iliopsoas muscle is supplied by the anterior branches of the second and third lumbar nerves. It is quite apparent, therefore, that this muscle remains unparalyzed, while all the muscles receiving their supply below the third lumbar lose their entire action. The management of these completely paralyzed cases has been the greatest problem for the bone and joint surgeon.

We have been content to permit such patients to get about as best they could with the aid of cumbersome leg and body braces. A few of the more daring surgeons have attempted to produce an arthrodesis at the hip and knee joints in an effort to stabilize the leg. The best evidence of the futility of these procedures is found in the fact that their

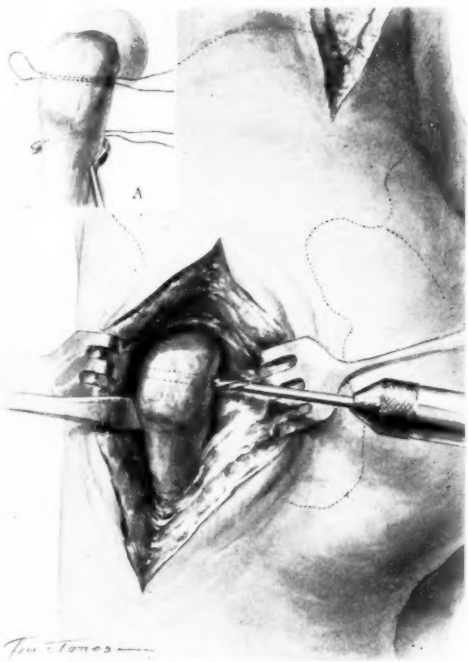

Fig. 3. The greater trochanter and a portion of the shaft have been exposed. The drill hole is being made from behind forward well down on the trochanter so that the silk cords which are subsequently passed through this opening will have a firm attachment. The lower end of the lumbar incision is at the top of the picture. *A*, A silkworm gut ligature has been passed through a drill hole, the silk cords are looped into it and drawn through. A large aneurism needle carries the strands of silk around the shaft of the femur just above the lesser trochanter.

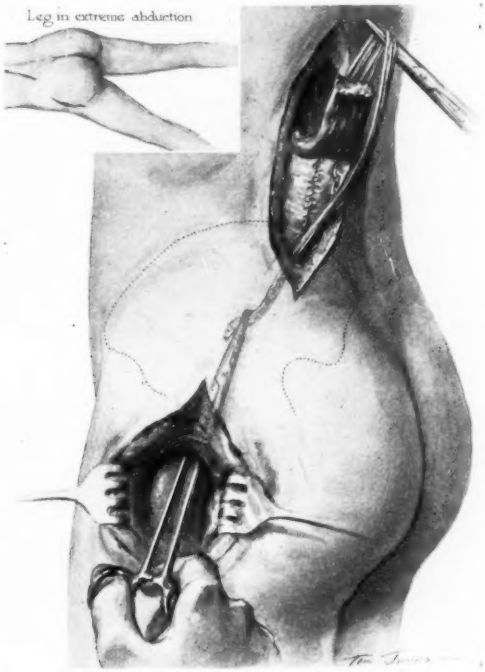

Fig. 4. A 12-inch forceps tunnels through the fat adjacent to the gluteal muscles and grasps all of the silk cords and draws them down for subsequent attachment to the femur. The insert at the upper left hand corner shows the position of extreme abduction while the ligatures are being tied.

practice has been discontinued to a very great extent. The great problem, then, in stabilizing the lower extremity can be solved only by producing gluteal muscle action. Samtor and Krukenberg attempted to substitute the external oblique muscle for the gluteus medius and gluteus minimus. We believe, however, that in anterior poliomyelitis the abdominal wall is often so weakened by the paralysis that it is not expedient to weaken it still further by utilizing any of the abdominal muscles.

Lange suggests the use of a portion of the erector spinæ muscle as a substitute for the glutei. Up to this time he has never published his operation. I performed the operation I am about to describe in March, 1924, so that it is quite probable my procedure differs, in many details, from the one he originally conceived.

The patient upon whom this operation was performed was a schoolgirl, age 10, who had a complete paralysis of all of the muscles of the left leg with total instability and who, according to the examinations of the surgeons who saw her and the attending neurologist, had a paralysis of all muscles acting upon the leg, except the iliopsoas.

The patient was the second of three children of normal birth; had whooping cough at 6 months; measles at 1 year. She was perfectly normal until September, 1921, when, at the age of 7, she became suddenly ill with high temperature and complete prostration. On the morning of the third day of her illness, there was present paralysis of both legs and of the spincters. At the end of 10 months she had regained complete control of her right leg and at the end of

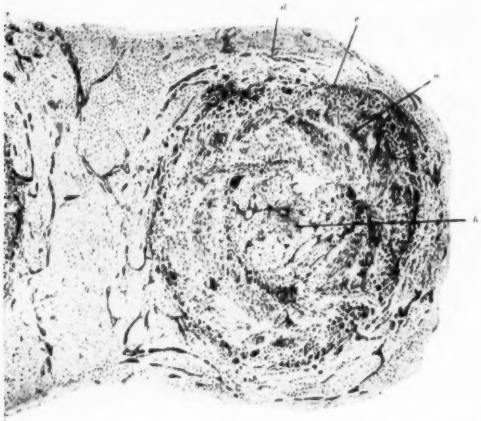

Fig. 6. A transverse section through two artificial tendons of silk. *a*, Silk strands; *b*, young nucleated cells in the interior of a silk strand; *c*, new fibrous material similar to tendons deposited around the silk cord; *d*, cellular material of false sheath. (After Lange, from Tubby's *Diseases of Bones and Joints*.)

Fig. 7. Longitudinal section of an artificial silk tendon. For explanation of lettering see Figure 6. (After Lange from Tubby's *Diseases of Bones and Joints*.)

1 year she had regained control of the spincters. The left leg remained completely paralyzed from the beginning. Ten months after the paralysis she began to stand on her right leg but was able to get about only by holding to a chair or table or leaning against the wall, hopping about the room while the paralyzed leg either was dragged along or dangled at her side. This was her form of locomotion when brought to Mercy Hospital for treatment.

With such findings I felt that she was an ideal subject for the stabilizing procedure. We substituted a portion of the erector spinæ muscle for the paralyzed glutei according to the following technique:

The patient is placed face downward upon the operating table. The lumbar spine is elevated by placing sandbags under the abdomen to make the erector spinæ muscle more accessible (Fig. 1). An incision about 8 inches long is made over the lower portion of the left erector spinæ muscle, beginning at the posterior crest of the ilium, upward along the long axis of the muscle. The muscle sheath is exposed and split longitudinally and the outer one-half of the erector spinæ is detached at the crest of the ilium and freed upward for about 6 inches. The sheath of the muscle is closed, leaving the detached portion lying upon it (Fig. 2). Two series of silk sutures each containing four strands are placed in the prepared stump of muscle from above downward in such a way as not to interfere more than necessary with the blood and nerve supply (Fig. 2). The sutures are left sufficiently long to reach well beyond the greater trochanter, their point of future fixation. A short curved incision with the convexity forward is next made, exposing the greater trochanter and a portion of the upper end of the shaft of the femur (Fig. 3). A 12-inch forceps is then carried from this incision tunneling its way through the fat adjacent to the gluteal muscular sheath upward and medially until its tip passes out the upper incision and grasps the silk sutures which have been placed in the erector spinæ muscle (Fig. 4). Through this fatty tunnel the sutures are drawn down and are ready for fixation. Two of them are passed through a drill hole which has been made through the greater trochanter and two are carried around the shaft of the femur just above the lesser trochanter. At this stage of the operation the leg is brought in extreme abduction and the silk is tied with sufficient tension to draw down the stump of the erector spinæ muscle but not so taut as to necrotize the muscle fibers. To provide a smooth sliding surface for the silk a piece of fascia lata 1½ by 2½ inches is sutured over the posterior aspect of the crest of the ilium. Thus we avoid a destruction of the silk strands as they pass over the iliac ridge. This accomplished, another tunnel is made from the greater trochanter directly upward to the crest of the ilium. To these two fixed points

two additional silk sutures are attached to aid in the abduction of the leg (Fig. 5, frontispiece). In all incisions the skin is closed without drainage. The entire procedure must be carried on with the strictest aseptic technique as even the slightest infection would necessitate the immediate removal of the silk and, in consequence, a failure of the operation. After the completion of the operation a leg and body cast is applied, and care is used to keep the leg in extreme abduction.

The silk which is used is sterilized by boiling to insure its asepsis. It is furthermore rendered antiseptic by placing it for 24 hours in a 20 per cent aqueous solution of the oxycyanide of mercury.

These strands do not long act as a foreign body. As Lange showed a number of years ago in an operation upon the ankle, the artificial part of the tendon quickly increases in thickness when the transplanted part begins to act. In one of his cases in which mercurialized silk was used the tendon was the size of the little finger 2 years after the operation (Figs. 6 and 7).

The artificial prolongations appear as blue-white tough fibrous cords, in the center of which the silk lies unaltered. Microscopical examination of an excised piece showed in the deeper and therefore older layers of fibrous tissue near the silk that the structure was identical with that of a normal tendon. In the superficial layers the appearance was also tendinous, with the addition of scattered vessels and connective-tissue cells.

The use of the erector spinæ muscle is almost ideal in that—

1. It permits us to conform with the long established rule, namely, that in transplantation of tendons or the use of silk sutures the traction must be in a direct line with the tendon or bone to which they are attached.

2. This muscle acts synergistically with the gluteal muscles for which it is used as a substitute.

3. Easily one-half of the volume of this muscle can be utilized without interfering with the normal erector spinæ action.

4. By dividing the muscle as described above one does not noticeably interfere with the blood supply of the loosened portion. There is very little bleeding from the muscle tissue itself when it is detached.

The abduction cast is permitted to remain for 8 weeks, during all of which time the patient is encouraged to exert abduction action. At the end of 2 months the cast is removed and the legs are placed in a Travois or similar abduction splint. This position is assumed for at least 6 months, or until such time as the silk has become securely attached and sufficiently organized to withstand the subsequent strain. The patient is then permitted to be up and about on crutches, being warned never to adduct the leg beyond the straight line of the body. Massage and electrotherapeutic measures are carried on over the entire extremity and mild electrical stimulation over the erector spinæ muscle for the purpose of strengthening it and developing it to the fullest degree.

At the end of 8 months our patient was able to place the entire weight of her body upon the leg operated upon and was able to walk without the use of a crutch or cane. This she was able to do for the first time since the paralysis 3 years and 2 months before.

For fixation of the knee joint we applied a small posterior splint. I very much prefer the use of this simple brace to the uncertain arthrodesis operation which would permanently stiffen the knee.

The result obtained in this case has been most gratifying.

1. We were able to restore complete stability of the hip-joint in a totally paralyzed extremity.

2. By the use of the erector spinæ muscle we were able to produce very definite gluteal action.

3. With a stable hip and gluteal action the patient is able to walk about unaided.

GYNECOLOGICAL CONDITIONS TREATED WITH RADIUM ALONE OR COMBINED WITH SURGERY[1]

Report of One Hundred Fifty-six Cases

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We have been using radium for the treatment of some gynecological conditions at the Brooklyn Hospital since January 1, 1921, a period of nearly 4 years. In that time, 156 cases have been treated, of which there have been 66 cases of chronic metritis at the menopause, 21 cases of fibroids, 41 cases of carcinoma of the cervix, 17 cases of carcinoma of the fundus, and 11 miscellaneous cases.

In all of these, the radium salt was used, contained in two 50 milligram tubes. The screens were a glass capsule containing the radium, a second capsule of platinum 1 millimeter in thickness and a rubber tube 2 millimeters in thickness. One half millimeter of platinum is supposed to absorb all the primary β-rays, and the emergent secondary β-rays are absorbed by the 2 millimeters rubber screen, so that our cases have received only γ-rays.

As you know, there are various materials used for screening purposes. In the absorbing power of β-rays, platinum has exactly twice that of silver or lead and nearly two and three quarter times that of brass, according to the Radium Company of Pittsburgh. We are indebted to Dr. Harold Bailey of New York for the suggestion that we use 1 millimeter of platinum as a screen and that by so doing we would probably avoid some serious injuries.

Our technique is to tie a strong silk thread into the eye of each platinum capsule. The capsules are then placed in a 20 per cent carbolic and alcohol solution for 20 minutes. The rubber tubing is boiled: a sterile nurse then inserts the radium capsules into the rubber tube, ties off both ends of the tube with silk, leaving a long thread attached to one end. By this means, we have a silk thread attached to the rubber tube and to each radium capsule. The screened radium is now ready for use. Later, the three silk threads are attached to the patient's thigh by adhesive plaster.

CHRONIC METRITIS

You will see that over half of our patients were suffering from chronic metritis or small fibroids.

The metritis cases were all at about the menopause age and gave no history nor physical findings of previous inflammatory trouble. The principal symptom was uterine bleeding. They were all subjected to a careful examination under anæsthesia, and uterine curetting. The curettings were later examined by the pathologist. If the diagnosis of chronic metritis was sustained by clinical findings at the time of operation, these patients received 1200 milligram hours of radium at one dose in two 50 milligram tubes in tandem, screened with 1 millimeter of platinum and 2 millimeters of rubber. Radium was carried well up to the fundus of the uterus, and kept there by a narrow strip of gauze packed into the cervical canal and the vagina was packed full of dry gauze. Patients have not had any difficulty in voiding, and we have not used a self retaining catheter, as is the custom in some institutions. Gauze and radium were removed 12 hours later, without difficulty or pain to the patients. Our rule is bed for 6 days.

The results have been very satisfactory. Uterine bleeding stopped in 5 or 6 weeks, and the uterus gradually became smaller in all but three cases. Two cases had a second radium treatment, 6 months to a year later, of 1200 milligram hours, which cured them, and the third case came to subsequent operation with a very interesting pelvic condition. A fourth case came to operation 1 year later for appendicitis, and as the uterus was large and soft, even though there had been no vaginal bleed-

[1] Read at the October meeting of the Brooklyn Gynecological Society.

ing, the surgeon performed a supravaginal hysterectomy.

Of these 66 cases of chronic metritis, 11 had the combined treatment of radium and surgery at the same sitting. The operative procedures were trachelorrhaphy, amputation, or repair of the anterior or posterior vaginal walls. In many of these cases, the radium was placed in the uterine canal and the rubber tube, used as a screen, stitched to the anterior and posterior lips of the cervix with a chromic gut stitch. This suture was tied with a half bow knot, leaving a long end which was carried out of the vagina and attached to the patient's thigh. When radium is thus fastened within the cervix and uterus, the vagina is not packed with gauze. We have had no bad results from not using the gauze packing and the repair operations have healed nicely.

In this group of 11 cases there is only one which had a Byrne cautery amputation of the cervix, and I will report it in more detail.

Mrs. S. W., age 33, Russian, was admitted to the hospital with a history of spotting between periods for 2 months. On examination, the uterus was found enlarged and hard with a cervix lacerated and eroded. The clinical diagnosis was a very early carcinoma of cervix or a chronic metritis with cervical erosions and lacerations. A circular amputation of the cervix was performed with the Byrne cautery knife leaving 2¾ inches of uterine canal. Two thousand four hundred milligram hours of radium were given within the uterus. The pathological report stated that the cervix was not malignant. Convalescence was stormy because of secondary hæmorrhage from the cervix. The patient left the hospital in 3 weeks with the cervix healed and in good condition.

Two years later this patient complained of abdominal pain once a month. There was never any flow and no fever. She looked well. Six months later the pain each month had increased and a presumptive diagnosis of hæmatometra was made, and a laparotomy was performed. The pelvic organs were very adherent, and there was a double hæmatosalpinx of considerable size, and the uterus was distended with old menstrual blood. A supravaginal hysterectomy with a double salpingo-oophorectomy was done. The stump of the cervix was split for drainage and the patient made a slow but satisfactory recovery.

Here is a case in which 2400 milligram hours of radium within the uterus failed to stop the menstrual periods for more than 1½ years. The menstrual function then slowly returned, but, as there was a stenosis of the cervical canal, due to the cautery amputation, there was no drainage and the blood backed up into the uterus and tubes.

FIBROIDS

The fibroid cases treated with radium were 21 in number. For the most part they were small fibroid tumors in the wall of the uterus, or small myomata. In only 3 cases have tumors larger than a fetal head been treated, and we have been careful to exclude submucous or pedunculated tumors, and those causing pelvic pain. With one exception, the patients' ages have been between 40 and 50 years. These patients were all subjected to a careful bimanual examination under anæsthesia and an intra-uterine investigation with a curette before the radium was introduced into the uterus. The usual radium dose was 1200 milligram hours. One patient received 1500 milligram hours and two received 2400 milligram hours at one session. The results have been excellent.

Patient, age 26, with a fibroid tumor extending 3 inches above the symphysis, was flowing heavily, and refused surgical measures. Radium was used after its effect had been fully explained to her. The result of one 1200 milligram hour dose was all that could be desired. The flow ceased, and the tumor slowly became reduced in size.

I know of only two cases where the bleeding did not stop with the single 1200 milligram hour dose. In both of these cases the periods have been reduced to normal in frequency and amount, the uterus remaining about stationary in size.

In one case surgery was combined with radium treatment. A myoma filling the pelvis was treated with a 1500 milligram hour dose, the tubes being sutured in place, and an extensive operation for lacerated perineum and rectocele was carried out with excellent result from both radium and surgery.

Two patients, with large fibroids, heavy flow, and very low hæmoglobin have had a 2400 milligram hour radium treatment, each as a preliminary to a later supravaginal hysterectomy. In each case the flow ceased, the hæmoglobin increased, and the patient became a good operative risk with eventual recovery after hysterectomy.

CARCINOMA OF THE CERVIX

We have had 41 cases of carcinoma of the cervix, of which 3 were of the epidermoid

variety and 38 were of the squamous cell type. Grouping these 41 cases in another manner, there were 34 which were inoperable; that is, there was induration in the broad ligaments and some degree of involvement of cervix and vagina; and there were seven cases which did not show extension into the broad ligament, as far as could be ascertained.

Making still another grouping of these 41 cases: One received radium treatment, and in 1 month the disease had spread very rapidly. One received radium treatment and 2 months later was subjected to a total abdominal hysterectomy.

Eight received a Byrne cautery operation and radium at the same session with or without later X-ray treatment, and 31 cases received radium alone or with X-ray as a palliative remedy.

The case with such a rapid advance of the disease was a widow of 39 years with a history of spotting between periods for 6 months. The cervix was eroded, only, and the uterus mobile. She received a 2400 milligram hour dose within the cervical canal. Cancer of the cervix was suspected, and the report from the pathologist confirmed it. One month later the cervix was entirely involved. She received heavy radium dosage in another hospital, and died 4 months after the first treatment. I do not know whether the treatment had anything to do with the rapidity of the course of the disease.

The patient who was subjected to radium and total abdominal hysterectomy was a married woman of 49 years. In 1919 her cervix and perineum were repaired. At that time, the pathologist reported that malignancy was suspected in the cervix. She was not seen again until 1923, when she complained of flowing and spotting a little between periods. On examination, the cervix bled a little to touch, and carcinoma was suspected. The uterus was small, hard, movable and there was no induration in the broad ligaments. She received a dose of 2400 milligram hours of radium within the cervical canal. A section of the cervix was reported by the pathologist to be epithelioma. Bleeding subsided after treatment. Three months later the patient was subjected to a total abdominal hysterectomy. Convalescence was uneventful. Seven months later she again came under observation with a small, hard nodule in the scar in the vaginal vault; the pathologist's report was squamous cell carcinoma. A second 1200 milligram hour radium treatment was given, the tubes being placed in parallel against the scar. Nine months have now elapsed, and the patient has gained 20 pounds in weight, and her general health is excellent. The vaginal vault is free and soft, and there are no nodules or granulations.

Of the 31 advanced cases which received radium as a palliative remedy, there were 3 which had received a supravaginal hysterectomy for fibroids from 6 to 14 years previously. These 31 cases have had their radium within the cervical canals with the tubes in parallel or in ⊥ fashion. They have nearly all had second doses of 2400 milligram hours after an interval of 4 to 6 months and many have been given X-ray treatment across the abdomen.

Of this entire group of advanced cases, some are dead, and some are living. Those that are living will eventually die from carcinoma, but I am of the firm opinion that radium treatment either alone or with X-ray is the best palliative remedy at our command. Life is prolonged, the foul discharge and the bleeding are very much decreased. Pain may or may not be less than without treatment. The patients gain in weight, they are able to carry on their daily duties, and they really feel as though something had been done for them. If this much can be accomplished for these poor unfortunates, I think that you will agree that this form of treatment is worth while.

Eight cases received the Byrne operation and radium. In this group, 2 cases had the cautery operation first, radium treatment following in 9 weeks, and 11 months respectively. The other six cases had the Byrne operation and radium at the same session. Five of this group of 8 patients have only been under observation for 1½ years or less, so it is too soon to speak of them, except to say that 4 are doing nicely, and that one is having a slow extension of the disease. This last case had some growth on the anterior vaginal wall which could not be entirely eradicated at the time of the operation, so the extension of the disease is not unexpected.

The other three cases are of interest.

One case came under observation on July 18, 1921, 3 years ago. She was 43, pale, thin and bleeding profusely. Examination of the cervix revealed a large cauliflower growth on the posterior lip. The uterus was mobile. It was possible to pull down the cervix and to get around it with the cautery knife. She received a Byrne operation, leaving 1¾ inches of the uterine canal. One tube of radium was placed in the canal and one tube was placed crosswise in the crater. The pathologist reported squamous cell carcinoma. Convalescence was stormy due to a second-

ary hæmorrhage. Two weeks after discharge, the patient was re-admitted to the hospital, suffering from another hæmorrhage. On discharge she went to the Home for Incurables and, after about 3 months she began to gain in weight and color. Six months later she was discharged from the Institution because the authorities there considered her too healthy to be retained as an inmate. This patient will not come for examination, but our social worker reports that she is alive and working at her household duties at the present time, 3 years after treatment.

The second of these cases was a married woman of 37 who came for observation on June 15, 1921, with an epidermoid carcinoma of the cervix. Her history was: menorrhagia for 4 months, spotting between periods, and some loss of weight, though she was not cachectic. The cervix was lacerated, eroded, bled easily to touch and the uterus was large and movable. The Byrne cautery operation was performed and 2400 milligram hours of radium were given at the same session. One tube was placed in the canal, and one crosswise in the crater. Convalescence was stormy, due to two secondary hæmorrhages. The patient finally left the hospital in good condition. Four months later she was re-admitted with a spotting history. She looked very well. The uterus was freely movable, and felt like a round ball in the pelvis. The uterine canal was easily dilated, and two radium tubes were inserted in the canal in tandem. Total dose 600 milligram hours. Since that time, this patient has had no spotting or discharge. The uterus is freely movable, and the patient feels well and attends to her household duties. It is now 3 years since her last treatment.

The third case in this group of three is a married woman of 39 who came under observation May 21, 1920, nearly 4½ years ago. She had a bleeding, cauliflower mass on the cervix, and a uterus which was not entirely mobile. The report from the pathologist was squamous cell carcinoma. A Byrne cautery operation was performed, leaving a uterine canal 2 inches in length. She did not have radium treatment at that time because we did not have any in our possession. Convalescence was easy. Prognosis was bad, and her family were told that she might live 6 months or a year. Two months later she suffered severe pain at her periods due to stenosis of the uterine canal. One dilatation of the canal cured the trouble. The patient gained weight and felt well for 1 year, then she noticed spotting between her periods. Examination showed a hard nodule in the scar of the Byrne operation. Section of the nodule was reported as squamous cell carcinoma. The uterine canal was dilated and one tube of radium was placed within the uterus, and one tube crosswise against the nodule in the vault of the vagina. Dose 2200 milligram hours. Her periods and all staining ceased. The patient had no complaints for 2½ years. She then became ill with severe abdominal cramps and some hours later a heavy flow appeared, lasting 4 days and resembling menstruation. Examination elicited no signs of extension of the disease. Six months later a similar attack occurred. She was re-admitted to the hospital, and examined under anæsthesia. The uterus was fully movable, and the pelvis was free and clear except for scar tissue due to the original cautery operation. The uterine canal was identified with difficulty, and dilated. A small amount of thin, serous fluid escaped from the uterus. Exploration of the uterine cavity with a curette produced little or no material. Two 50 milligram tubes of radium in tandem were placed within the uterus. Dose was 2400 milligram hours. Since that time, 8 months ago, the patient has been in excellent condition. There have been no more attacks of bleeding and no discharge. There has been no change in vagina and uterus on palpation. On inspection there is a small, red area at the entrance of the uterine canal. This area does not bleed on sponging and it is soft to touch.

I think the last two attacks of bleeding were a beginning return of ovarian function, and the pain was undoubtedly due to a stenosis of the opening of the uterine canal. I doubt very much whether radium had anything to do with the secondary hæmorrhages reported in these cases. I rather think that they are due to the high Byrne cautery operation which may have been done too rapidly or with too great a degree of heat.

For these hæmorrhages, our treatment has been a free use of morphine and raising the foot of the bed.

ADENOCARCINOMA OF THE CORPUS UTERI

Of the 17 cases of adenocarcinoma of the corpus, 7 were advanced, and 10 were fairly early cases, that is, the fundus was movable, and there was no demonstrable induration in the broad ligament. All these patients were between 38 and 60 years of age.

The advanced cases were given 2400 milligram hours of radium within the uterine canal. Four of these cases had abdominal X-ray treatment and three did not have it. None of this group was operated on. Three patients had a second 2400 milligram hour radium treatment 6 months after the first, and one patient has had three such treatments. Of these seven advanced cases, four have died, two have disappeared, and one is living, 1½ years after the first treatment.

This is the patient who has had 7200 milligram hours of radium within the uterus, in addition to X-ray. She has no bleeding, and no watery dis-

charge, but her pelvis is filled with a hard, immovable mass, and there is extension into the cervix. She will eventually die of cancer.

I feel quite certain, however, that radium has relieved this group of women of considerable bleeding, much foul discharge, and prolonged their lives.

The ten cases with movable uterus, and no demonstrable broad ligament induration, received a 2400 milligram hour dose of radium within the uterus. Two of the cases were subjected to a complete abdominal hysterectomy 10 days after their radium treatment, and the remaining 8 had their hysterectomy 6 weeks after their radium.

Eight of these patients are alive, and doing nicely, 1 to 3 years after operation. Of the remaining 2 cases, one died of general peritonitis a few days after the hysterectomy, and the other is having an extension of the disease in the vault of the vagina 2 years after operation. This patient, however, had an extension of her trouble in one tube at the time of her hysterectomy, so the outcome is not entirely unexpected. Curiously, these two are the only patients who had early hysterectomies.

In this group of ten cases of which I have been speaking, there is one which I will report in detail, because her abdomen had been opened and her uterus and ovaries inspected 2 weeks before her radium treatment. She was then subjected to a total abdominal hysterectomy 6 weeks after her radium treatment, and her pelvic organs were again inspected and sent to the laboratory for section.

Miss Y., age 38, school teacher, was admitted to the surgical service with the symptoms of chronic appendicitis, and the history that her periods had been profuse for several years, and that she had been spotting between periods for 3 months. She was curetted, and a laparotomy was performed for chronic appendicitis and retroversion. When the abdomen was opened the uterus was a bit large, congested, and retroverted, both ovaries were large and congested; the broad ligaments soft. The curettings, which had not excited suspicion on gross inspection, were reported as adenocarcinoma by the pathologist. Two weeks after the laparotomy, she was given 2400 milligram hours of radium within the uterus as a preliminary to total abdominal hysterectomy performed 6 weeks later. At this last operation the ovaries on gross inspection, were small and atrophied. On opening the uterus it was possible to see where the radium capsules had been placed, and no carcinoma could be seen in gross. She is apparently well at present.

The pathologist's report is as follows: Specimen consists of uterus, ovaries, and tubes. Pathological diagnosis: carcinoma of uterus; localized acute and subacute endometritis (Radium).

The fundus consists of firm, whitish tissue, the fibers arranged in whorls. This area is indistinctly demarcated from the surroundings; it appears to be carcinomatous. There is a patch 1 centimeter in diameter, on the endometrium of the lower part of the body of the uterus, consisting of soft yellowish fibrin; it is surrounded by a zone of congestion. The tubes and ovaries appear normal, though ovaries are small and atrophied.

Microscopic examination. Ovary: No follicles are present. Many small arteries show obliteration of the lumen by a process of finely granular degeneration affecting the vessel and giving it a slaty blue stain. Similar areas of large size, possibly follicles, are seen. No other pathological changes are evident.

Fibrinous patch on endometrium consists of fibrin containing many polymorphonuclear cells; beneath it is a zone containing young fibroblasts and polymorphonuclear cells. Under one end of the patch is a dilated gland, with bizarre epithelium; it appears to be altered in the inflammatory process rather than malignant. In places the leucocytes are fragmented and necrotic. No mucosa is present. In some places beneath the fibrin and extending into the muscular wall are nodular accumulations of round cells about groups of giant cells, the whole suggesting a tubercle. The blood vessels beneath this inflammatory zone are thick-walled, the intima being chiefly involved. The lumina of some are entirely obliterated; in others the lumen is filled with organizing thrombus or contains large pale cells, evidently fat-containing cells. The process in this region appears to involve essentially a destruction of the mucosa, and the underlying tissue, including the blood vessels of all sizes with an inflammatory cellular reaction determined by the products of this destruction.

No carcinoma is evident either in the muscular wall or the atrophic mucosa of the central portion of the fundus. In one small area of a block cut just to the left of this region, the mucosa is covered by a straggling network of epithelial cells which approach squamous cells in type and in a few cases show distinct cell-bridges. There is an abundant infiltration of small round cells, which obscures the stroma. The mucosa and wall do not appear invaded.

Review of the curettings removed earlier confirms the diagnosis of adenocarcinoma. There is no evident relation in type between these tumor glands and the growth above described. It is possible that a metaplasia has been the result of radium.

If radium has any effect at all on the parametrium and you will probably agree that it has, then I think, it is logical to use radium as

a preliminary to total abdominal hysterectomy in the treatment of early fundal carcinoma.

MISCELLANEOUS CASES

Of the 11 miscellaneous cases, 3 were in young women with chronic discharges from the cervix following old gonorrhœal infections. They received 400 to 600 milligram hour treatments at one session. Radium was sutured within the cervix. One case is too recent to speak of in regard to results. The other two patients each missed one period and their discharges have been very much lessened. They are not entirely cured.

There have been three cases of hyperovarian function in young women. Radium was used within the uterus after an exploration of the uterine cavity with a curette. Dosage 400 to 600 milligram hours. All these patients have been greatly benefited and there has been no lasting damage to the menstrual periods.

Five cases were suffering from chronic trachelitis, and erosions of the cervix. These patients were all about the menopause age. They were poor operative risks from general causes, and they received 1200 to 2400 milligram hours of radium against the cervix or in the cervical canal. None of these cases was considered malignant by the pathologist. The results have been that the cervices have all been reduced in size and the erosions have healed.

REACTIONS

Practically every patient who has had radium inserted within the uterus has suffered from nausea and vomiting while the radium tubes remained in place. The symptoms subside as soon as the tubes are removed. We are of the opinion that the nausea is caused by the foreign body within the uterus and that it is not necessarily due to radium. Patients have reported very little troublesome leucorrhœa.

There have been only two patients who have complained of bladder symptoms following radium treatment. One had an advanced carcinoma of the cervix and anterior vaginal wall, and the radium was placed directly against the parts affected; the other case was one on whom a Byrne cautery operation was performed. She had some extension on the anterior vaginal wall at the time of the operation. She has now a vesicovaginal fistula, which may be due to the disease, the cautery, the radium or to all three. There have been no cases of stenosis of the cervix or adhesive vaginitis due to radium in the entire group. There has been only one patient who has complained of rectal symptoms. She was treated with a Byrne operation and radium within the uterus. A troublesome proctitis continued for some time. We wonder whether the radium did not slip out of the uterus into the vagina. Only four temperature reactions have been noted in this entire group.

One case had a 600 milligram hour dose within the cervix for chronic leucorrhœa following gonorrhœal infection 2 years before. Smears had been negative for 6 months. Examination showed a small, movable uterus, and no adnexal masses. There was no curetting. The cervix was dilated, and the radium was sutured in place for 6 hours. Seventy-two hours later the patient had a chill, a fever of 102, sharp pain over lower abdomen, and she began to flow. Leucocyte count was 18,400 with 80 per cent polynuclears. The fever continued for 24 hours, and gradually subsided, as did the leucocytosis, pain and flow. The pelvis remained clear of adnexal masses, but the cervix was very tender on motion.

The second case with a serious reaction was a woman of 45 with a diagnosis of chronic metritis. There was no history of pelvic inflammation and no adnexal masses were palpated. She was curetted and given a dose of 1200 milligram hours within the uterus. Her convalescence was uneventful until the fifth day, when she suddenly developed severe nausea, vomiting, diarrhœa, and a fever of 103. The leucocytes increased to 27,000 with 85 per cent polymorphonuclears. The gastro-intestinal symptoms slowly subsided, there never were any pelvic symptoms, subjective or objective. Blood cultures were sterile on several occasions. She finally developed fluid in the pleural cavity which showed no organism on culture, or after injection into a guinea pig. Finally pus developed in her left forearm, which was opened and drained. After remaining in the hospital for 2 months she was discharged and has remained in good health ever since.

The third case with a fever was a case of advanced carcinoma of the cervix with extension into the posterior wall of the vagina. Radium tubes were thought to have been placed in the uterine canal. Owing to the friability of the diseased cervical mass, the identification of the canal was very difficult. The dose was 2400 milligram hours. Convalescence was easy until the fifth day when a fever of 102 occurred with lower abdominal pain. Fever continued, gradually reaching normal 7 days later. Abdominal examination elicited that the pelvis and lower abdomen were filled with a hard exudate, which continued for a period of 3 months, slowly

subsiding without further symptoms. At the present time this patient is in excellent general health, free from pain, foul or bloody discharge. The disease, however, is slowly extending along the posterior vaginal wall.

The fourth case with a disastrous reaction, was due to streptococcus hæmolyticus. The patient was a Russian of 42 years. She gave a false history. Our clinical diagnosis was chronic metritis, and she was subjected to a curettage and 1200 milligram hours of radium. The true history was that she had an induced abortion a few weeks previous to admission. Her convalescence was uneventful for 5 days, then her temperature rose to 104, with a pulse of 120, and she complained of painful areas over the veins of her legs, and painful wrists. She appeared very ill. Leucocyte count was 5400, with 83 per cent polymorphonuclears. Blood culture showed streptococcus hæmolyticus. Death occurred 6 days after the onset of the fever.

SUMMARY

My impressions are that—

1. Radium, heavily screened with one millimeter of platinum and 2 millimeters of rubber and used within the uterus in 1200 to 2400 milligram hour doses, even with repeated administrations, causes no untoward effect on bladder and rectum and produces very little troublesome leucorrhœa. If the radium is used within the vagina without careful protection of bladder and rectum, it will cause a reaction; but not nearly so disastrous as would be the case if β-rays were used.

2. The temperature reactions occasionally seen are more likely to be due to a fresh invasion by organisms started by the curetting and blocked drainage than to radium.

3. Radium alone is an excellent treatment for chronic metritis and small fibroids at the menopause age, curing most of the cases with one 1200 milligram hour dose; but even a 2400 milligram hour dose will not always control the bleeding indefinitely in all patients.

4. Plastic operations on cervix and perineum may be performed with excellent results at the same time that radium is applied to the interior of the uterus.

5. For advanced cases of cancer of the cervix and corpus, radium, as a palliative measure, gives more relief than any other treatment at our command.

6. In early cervical cancers, the Byrne cautery operation, and radium at the same session, with or without X-ray treatment later, give results which are so valuable that it should be thoughtfully considered as a possible standard method of treatment.

7. It is impossible to forecast how much or how little radium treatment will accomplish for any particular patient suffering from carcinoma.

I am indebted to all the members of our staff for the privilege of reporting on their cases which have been treated with radium.

MOVABLE KIDNEY[1]

By CHARLES P. MATHÉ, M.D., San Francisco, California
From the Department of Urology, Saint Mary's Hospital

MY interest in the study of this group of cases of movable kidney was stimulated by the divergence of opinion expressed by urologists, general surgeons, and internists in their treatment. Some advocate surgical suspension in all cases, others support by mechanical belts or bandages, while another group of men fail to recognize this lesion as a clinical entity. In the Mayo Clinic these cases are treated with abdominal supports, whereas Lowsley in New York uses surgical suspension in those patients in whom the belt fails to relieve the symptoms. Kretschmer in Chicago favors abdominal supports and reserves nephropexy for the unusually mobile type of kidney. Kelly in Baltimore, and his pupils, notably the late J. Craig Neel of San Francisco, have employed nephropexy with great success. Frank Hinman utilizes surgical suspension in addition to abdominal supports in nephroptosis where the drop has caused a kink of the ureter and resulting back pressure. J. J. Bell has reported 300 cases, 200 of which were treated with a belt, and states that the support thus acquired is unsatisfactory and that he has never seen a cure from its use. In France and Germany both bandages and surgical suspension are used in fixing and holding the kidney in place. Over a period of 7 years I have made a thorough urological study of 90 cases, with a complete cystoscopic examination, including urine analysis, functional study of the kidneys, and pyelography in each case. In this way I hoped to arrive at an intelligent and rational form of therapy suitable to the individual case. (Fig. 1.)

Movable kidney or nephroptosis are terms applied to kidneys abnormally movable. The average mobility of the kidney in the abdomen in respiration is generally believed to vary from 2 to 5 centimeters. Kelly and Burnam in making 48 postmortem examinations measuring from a fixed point on the sacral promotory, found the mobility to average 4 centimeters on the right and 4.5 centimeters on the left side. The perirenal fat in its posterior attachment is so loose that it offers no resistance to the mobility of the kidney. It was formerly thought that the kidney in normal position could not be palpated even in deep inspiration. Kelly and Burnam in a collection of 7,853 autopsies showed that movable kidney occurred in 22.8 per cent of the women and 2.1 per cent of the men examined. In making routine abdominal examinations, gynecologists and surgeons point out the frequency of palpable kidney. The recent work of Moody, Van Nuys, and Chamberlain indicates that the abdominal organs, the stomach, liver, and colon, on account of the upright position of man have a position much lower than formerly accepted, in fact, extending caudad to the iliac line. Buedinger in studying 60 cadavers dying from acute infections in which kidney disease played no part, found a greater excessive mobility than formerly reported. Palpable kidney is repeatedly found but causes no symptoms or damage. There is a certain group of cases, however, n which the increased mobility of the kidney results in kinking of the ureter, renal torsion, and hydronephrosis. The resulting back pressure may cause pain, persistence of chronic renal infection, loss of weight, urinary symptoms, etc. It is the group of movable kidneys causing symptoms that I am dealing with in this paper. (Fig. 2.)

In 1881 Landau pointed out that the normal diaphragmatic excursion imparts motion to the kidney. In 1885 Glénard made his classical study of visceroptosis including movable kidney. He regarded nephroptosis as a part of a general splanchnoptosis and divided movable kidney into three groups. Nephroptosis of the first degree included those in which the lower pole could be palpated and not retained by the examining hand in expiration, second degree those in which the lower pole and the renal notch were palpated and

[1]Read before the Urological Section of the San Francisco County Medical Society, September 30, 1924.

retained by the examining hand in expiration, and third degree, the entire kidney could be palpated both during inspiration and expiration. The term floating kidney has been applied to the latter group. In this group the kidney moves more or less freely in the abdominal cavity, sometimes having a distinct mesonephron. (Figs. 3 and 4 and Tables I and II.)

TABLE I.—INCIDENCE ACCORDING TO SEX

	Cases
Female	72
Male	18
Total	90

TABLE II.—OCCURRENCE OF MOVABLE KIDNEY

	Cases
Right kidney	70
Left kidney	11
Bilateral	9
Total	90

TABLE III.—CONCURRENCE WITH SPLANCHNOPTOSIS

	Cases
Cases with general visceroptosis	7
Cases with no clinical or positive evidence of visceroptosis	83
Total	90

TABLE IV.—INCIDENCE ACCORDING TO AGE

	Cases
10–21	*13
20–31	40
30–41	18
40–51	9
50–61	†10
60–71	0
Total	90

*Youngest, 13 years.
†Oldest, 61 years.

OCCURRENCE

Movable kidney occurs more frequently in women than in men. It is more frequent on the right side, probably because of the more shallow renal fossa with the wider lower end, and to the relative lower attachment of the hepatic flexure. Furthermore, the retrorenal fascia of Zuckerkandl is usually well developed on the left and is very variable on the right. In addition to this there is the fascial leaf of Toldt lying between the peritoneum and the prerenal fascia of Gerota, which is constant on the left and absent on the right. Furthermore, the pre- and retrorenal fasciæ fuse laterally and above, enclosing the kidney and the adrenal body, whereas below, the fascial support is open, the prerenal leaf fusing with the posterior peritoneum and the retrorenal leaf losing itself in the fat of the iliac fossa. These fasciæ by their superior attachments to the diaphragm and posterior attachments to the spinal column and the muscles of the posterior abdominal wall give a much stronger support to the left kidney. Movable kidney occurs usually after puberty, and is more common in the third and fourth decades of life. It often occurs associated with general splanchnoptosis in which the abdominal viscera is abnormally movable. (Figs. 5 and 6.)

ETIOLOGY

The etiology of movable kidney has been a source of considerable study and speculation. The renal supports may be classified as follows: A, general, including body form and position, muscle tone, peritoneal attachments and intra-abdominal pressure; B, local, including ligamentous attachments to the liver, pancreas, duodenum, and spleen. Perirenal fascia, the perirenal fat, or so-called fatty atmosphere of the kidney, vascular pedicle, and attachment to the adrenal gland. The early French investigators, notably Riolan, 1682, and later Rayer, 1841, thought that stone or tumors occurring in the kidney by their increased weight loosened its attachment in the renal fossa, causing mobility. However, a moderate sized stone or tumor would hardly exceed the weight of an early congested kidney, which does not exceed 25 grams and could hardly be considered as a potent factor in displacement. In fact, these lesions often lead to adhesions to the surrounding structures of the kidney and fatty capsule, more or less anchoring the kidney in place. The retained fluid in a large hydronephrosis might be effective only after the sac had reached large proportions. (Fig. 7.)

Congenital predisposition. In 1895 Albarran ranked movable kidney with the body stigmata of degeneracy. In noting that it often occurs in individuals of the same family he concluded that there must be a congenital predisposition. Steller finds them associated

with dilatation of the stomach and a floating tenth rib. In 245 cases reported by Kelly and Burnam, only 26 had a marked splanchnoptosis, which contradicts the importance of hereditary factors. Many of the patients in this series of cases were perfectly normal physically and came of healthy, strong families. (Table III.)

Erect position of man. Southam lays stress on the erect position of man as a factor in weakening the fixation of the kidney. In quadruped animals the kidneys rest upon a horizontal shelf of fascia which lies upon the peritoneal viscera. The diaphragm imparts to the kidney a slight to and fro movement. In assuming the upright position man loses this horizontal support which now lies in front and not below as in quadrupeds. The renal fossæ have become wider instead of deeper. With the widening of the bony pelvis in the female the lower ends of the fossæ have become more open. In this series of 90 cases only one occurred before puberty. It is apparent from these factors then, that in the process of evolution, man, in adopting the upright posture, has lost to some extent the security of the kidney. (Table IV.)

Peculiar body form. In 1869 Professor Botkin, in St. Petersburg, was the first to call attention to the possibility of nephroptosis resulting from a peculiarity of body form and to advocate the examination of patients in the standing position. He inspired the work of Wolkow and Delitzin, who demonstrated that deviation of the anatomical configuration of the posterior abdominal wall was a distinct factor in producing prolapse of the kidney. They experimented on 70 cadavers and with the aid of their ingenious fixation apparatus, the kinematometer, made plaster-of-Paris casts of the renal fossæ in the horizontal and vertical positions. In well developed men the renal fossæ were found to be rather deep depressions that taper downward, resembling an inverted pear. In women, the fossæ were shallow, cylindrical, and, in some cases, wider below, resembling an inverted funnel. The shape and depth of the fossæ were found to vary with posture. The fossæ were deeper and the lower end narrower in the dorsal position, whereas in the standing position the fossæ were shallower with the lower end wider. This was more marked on the right side. In summarizing the cause of nephroptosis, they stated that it was the result of an anatomical insufficiency of the renal fossæ. It occurred more frequently in women and especially on the right side. This was aided by a change of the normal intra-abdominal equilibrium, caused by descent of the diaphragm, laxness of the abdominal wall, sudden changes in abdominal tension and trauma. (Figs. 8 and 9.)

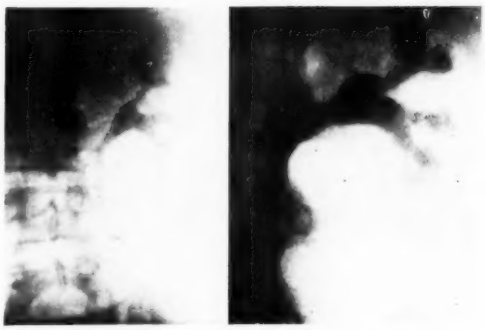

Fig. 1. Dorsal and vertical pyelograms showing normal mobility. Note the lack of kinking of the ureter in either position.

Tight lacing. On account of its frequent occurrence in civilized women, tight lacing has been given as a cause of movable kidney, particularly by the older investigators. Becker and Lennhoff in examining 24 Samoan women, who never wore corsets or any clothing which bound the abdomen, found 6 to have palpable kidney. They reiterated the opinion of Wolkow and Delitzin that body form and fallen kidney were connected, that a certain or positive type will have a palpable kidney and a negative type will not. The positive type was thin, had poor posture, long narrow thorax, with soft ptotic viscera. The negative type was characterized by a broad thorax, round abdomen, and relatively short length with large sagittal and frontal diameters. With this in mind it was decided to find an equation which might express this difference in body form, namely, an index. After trying a number of different measurements it was found that the following equation expressed what they were looking for.

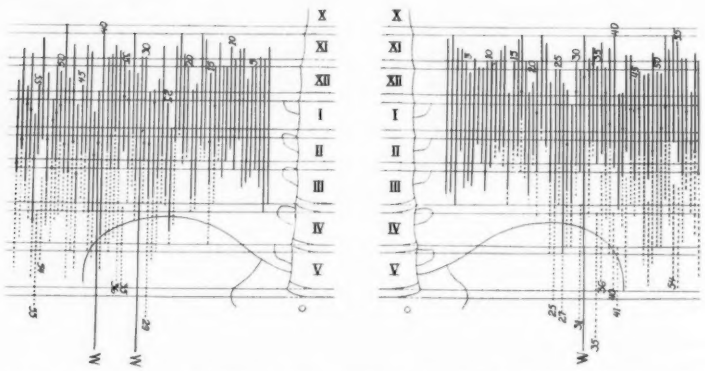

Fig. 2. Schema of Buedinger. Sixty random autopsies. Solid line indicates position of the kidney, dotted line, its mobility.

$$\text{Index } \frac{\text{Distantia jugulo-pubica}}{\text{circumferentia abdominis}} \times 100$$

$$\text{Or } \frac{\text{D. J. P.}}{\text{C. A.}} \times 100$$

They measured 300 normal German women and found the renal index to average 77. The negative type was found to have an index below 77, the positive type was above 77. In the 90 cases reported in this paper 30 were measured, 27 were found to have a positive renal index and 3 negative. (Table V and Fig. 10.)

TABLE V.—RENAL INDEX TABLE

	Cases
Positive above 77 (77 to 89)	27
Negative below 77 (69, 70, and 70)	3
Total	30

The greater the distance between the sternal notch to the symphysis pubis, and the smaller the abdominal circumference, the higher the index with the greater probability of palpable kidney. With a short distance from the notch to the pubis, plus a large abdominal circumference the less probable a palpable kidney. In studying 107 cases, Harris confirmed these findings. He says stress on the contraction or diminution of the capacity of the mid-zone of the body. The lower plane of the zone touches the anterior extremities of the tenth, eleventh, and twelfth ribs. In lateral or anteroposterior flexion movements of the body and muscular efforts, lifting, sneezing or coughing, in which the lower ribs are adducted, this plane becomes the point of greatest constriction of the body. In the normal body forms, this point of constriction lies below the greater portion of the kidney so that when the body is narrowed by muscular action the tendency is not to depress the kidney but rather to hold it up. In bodies with contracted mid-zones in which the kidneys are crowded lower than normal, the line of constriction lies above the major part of the kidney, therefore all acts narrowing this plane tend to depress it. This depression causes loosening, elongation, and stretching of the fasciæ supporting the kidney, thus favoring greater mobility. J. J. Bell, in a recent report of 300 cases collected from a large practice in the manufacturing towns of England, states that the too early employment of young girls in the occupations requiring long standing, weight bearing, and repeated flexion of the body, tends to produce and aggravate the condition of movable kidney in those individuals having a positive renal index. Glénard considered that patients having movable kidney had a congenital weakness of all the structures supporting the abdominal viscera and that movable kidney was only a part of a splanchnoptosis. (Table VI.)

Pregnancy and labor. Because of the higher incidence of cases of movable kidney in women, pregnancy and labor were given as a cause. In this series of 90 cases, 23 were found in single women, 25 in nullipara, and 14 in

TABLE VI.—INCIDENCE ACCORDING TO PREGNANCY

		Cases
Single		23
Married	Nullipara	25
	Parous women	24
Total		72

parous women. Our observations agree with those of other investigators, particularly Bell, who have noted that movable kidney occurs as frequently in nullipara as in parous women and therefore pregnancy cannot be a great factor in its production.

Rapid absorption of perirenal fat. The rapid absorption of the perirenal fat has also been held as a factor in the establishment of renal ptosis. However, as many of these patients lose weight as a result of symptoms caused by movable kidney, it is not easy to determine which is primary, the rapid absorption of fat or the loss of weight. Numerous movable kidneys have been observed in persons with a large amount of perirenal fat, while in those with very little fat the kidneys have been found in good position. Furthermore, if movable kidney follows wasting diseases, as advocated by Dietl, it should occur equally in men, yet we know that this condition is much more frequent in women. (Figs. 11 and 12.)

Trauma. The question of trauma is of interest from the standpoint of industrial medicine and surgery. Patients are wont to attribute their trouble, particularly when there is a question of compensation, to trauma or injury. On the occasion of a fall, severe exertion, etc., a movable kidney may suddenly present so-called strangulation symptoms and thus for the first time become known to the physician and patient, although it had existed for years without symptoms. It is generally agreed in the literature that there is usually the predisposing cause, the peculiar body form described by Wolkow and Delitzin, with a positive renal index. The traumatic causes may be divided into acute and chronic. The acute traumata include falls on the feet or lumbar region, blows in the loin and sudden depression of the diaphragm. Among the chronic may be mentioned long standing, weight bearing, repeated flexion of

Fig. 3. Pyelogram of female aged 61 years, with bilateral dull lumbar pain. Generalized visceroptosis with bilateral nephroptosis. Symptoms relieved by belt, fattening, etc. Note relatively lower position of right kidney.

the body in the lateral and anteroposterior direction, continuous jolting of various exercises, such as horse-back riding and motor trips over rough roads, excessive straining of a repeated severe cough, or such that occurs in some cases of marked constipation. Forty-one of Harris' 107 cases attributed their movable kidney to a railroad accident. He is of the opinion that movable kidney is never the result of a single trauma. He thinks that it is possible to injure, crush or suddenly displace the kidney by violence, but that this is accompanied by laceration of the perirenal tissues, tear of the peritoneum or even severance of the renal vessels. The kidney, however, may be slowly displaced by hæmorrhage into the perirenal fat. Herrick is of the same opinion. Sulzer does not think that traumatic displacement is possible without the abnormal body form described above. It is of interest to note that Wolkow and Delitzin dislodged the kidneys in cadavers by acute artificial trauma. One cannot fail to recognize that a sudden fall, trauma to the lumbar region, or depression of the diaphragm may cause further displacement of a former movable kidney, with symptoms never previously noted. In the 9 cases of this series with ptosis attributable to trauma, 3 had negative renal indices. The 6 others had positive renal indices, and the trouble was the result of more or less

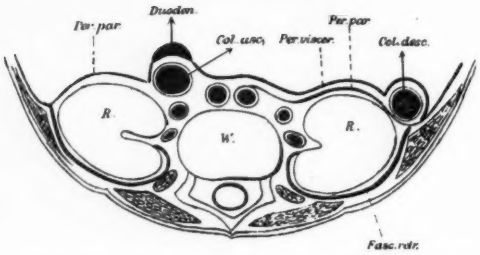

Fig. 4. Cross section through kidneys showing the retrorenal fascia described by Zuckerkandl. (From Zuckerkandl.)

chronic traumatic causes—long automobile rides over rough roads, horse-back riding, lifting of a heavy wash tub, raising of a picture frame above the head, standing long hours in a candy store, and moving a patient weighing 200 pounds by an intelligent trained nurse. Kelly and Burnam are convinced that a considerable number of patients develop movable kidney as a result of trauma.

Menstruation. Menstruation has been described as a predisposing cause of movable kidney as a result of the increased weight due to the congestion of the organ at this time. As pointed out before, the greatest increase in weight in congestion of the kidney would not exceed 25 grams and could hardly be a factor in producing increased mobility. Pain in any locality of the body is liable to be exaggerated at the time of the menstrual period.

Displacement of abdominal organs. The displacement of the liver, spleen, and stomach, the dragging of the cæcum and dilatation of the stomach have also been given as causes of movable kidney. However, as the kidney is not surrounded by peritoneum it is hard to conceive how these things could influence to a great degree its position. Wolkow and Delitzin exercised traction on the ascending and descending colon, injected water into the colon, and in no case produced renal ptosis.

In conclusion, the production of movable kidney seems to depend on a number of predisposing and active causes. The predisposing causes are the deviation in the anatomical configuration of the posterior abdominal walls, the shallow, cylindrical or funnel-shaped paravertebral fossæ of Wolkow and Delitzin, loss of the security of the kidney due to upright posture, and the laxness of the general and local renal supports. The active causes are various acute and repeated chronic traumata.

PATHOLOGY

Movable kidney is not always liable to infection, in fact most cases do not even develop hydronephrosis as evidenced by its frequent occurrence in kidneys having normal pelves, function, and urine findings. However, because of faulty drainage, movable kidney is, in certain cases, the cause of intermittent or progressive hydronephrosis. Kinking of the ureter occurs particularly in patients with aberrant renal vessels. It is also a cause of renal torsion, and a factor in the persistence of pyelitis due to the colon bacillus and other organisms. (Fig. 13.)

The increased mobility occurs from variations of several factors holding it within the limits of normal mobility. Unless the ureter has some point of relative fixation, or moves from forces acting in a different line from those affecting the kidney, the drainage of urine would be satisfactory and no trouble would result. Herrick has shown that the relatively more fixed ureter does not sag with the kidney. He demonstrates that the mobility of the ureter is separate from that of the kidney, that the ureter is fixed to the peritoneum 3 to 4 centimeters from the mid-vertebral line, that its movement is limited by the peritoneum, and that the upper 4 or 5 centimeters of the ureter leaves the peritoneum, passes through the perirenal fat, is mobile, and subject to angulation. The ureter usually leaves the peritoneum about 1 centimeter above the point of crossing of the spermatic or ovarian vessels. It forms a triangle with the renal vein and spermatic vessels, and at the apex of the triangle where the spermatic vessels cross the ureter is the point at which angulation occurs, being the highest fixed point of the ureter. The prerenal fascia in some cases merges with the parietal peritoneum toward the mid-line below the lower renal pole. This structure offers further chance for fixation of the ureter. The kink of the ureter as a result of undue mobility of the kidney at its highest fixed point has been pointed out by Barney and later by Sisk, to exist more frequently

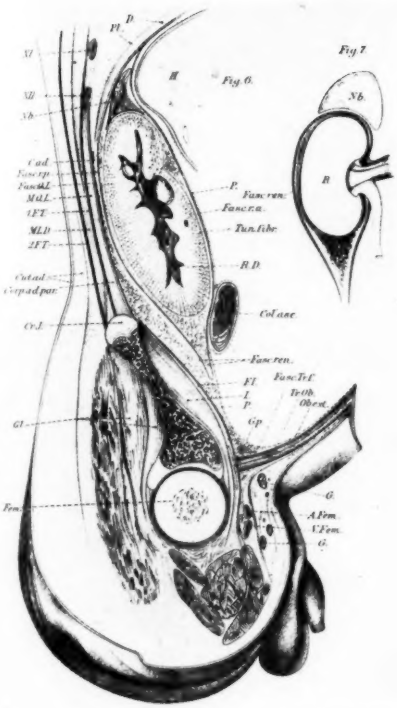

Fig. 5. Sagittal section through right kidney showing prerenal and retrorenal fascia. Fasciæ do not fuse below. Except for a small rudimentary fascia of Toldt behind the ascending colon at the lower anterior portion of the right kidney there is only one prerenal fascial layer. On the left side the anterior fascial support is stronger because the fascial leaf of Toldt reduplicates the prerenal fascia. (After Gerota.)

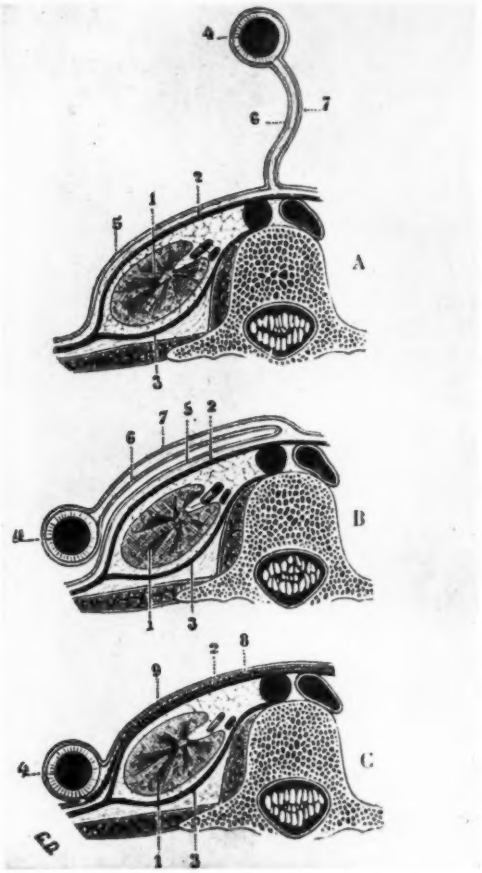

Fig. 6. Cross section of left kidney showing development of Toldt's fascia. (From Testut.)

than formerly was thought, and can be demonstrated in a ureterogram by pulling the catheter well down in the bony pelvis and injecting the ureter separately. The kink can be formed by a firm band of adhesions, lack of support of the ureter, by an inherent weakness or herniation of the normal sheath, and as the result of a hydronephrosis. (Fig. 14.)

Braasch gives ptosis as the most common cause of acquired renal torsion in which the kidney pelvis lies horizontal with dilatation of the pelvis and calices. He is of the opinion that the frequent attacks of renal crises are due to the pressure of an extrarenal organ or band of tissue with the ptosis only as a secondary factor. (Fig. 15.)

Crabtree and Sheddon give sagging kidney as an important factor in the persistence of colon bacillus pyelitis. In studying a series of cases of long standing colon pyelitis they were led to believe that lesser degrees of stasis in the renal pelvis of ptotic kidneys play a more important part than is generally recognized.

The orthostatic or intermittent albuminuria of young adults occurring in conjunction with movable kidney has been recently emphasized by Peacock. The sagging of the kidney with stress on the vessels causes congestion of the kidney producing albuminuria. This explains the disappearance of the albumin by relieving

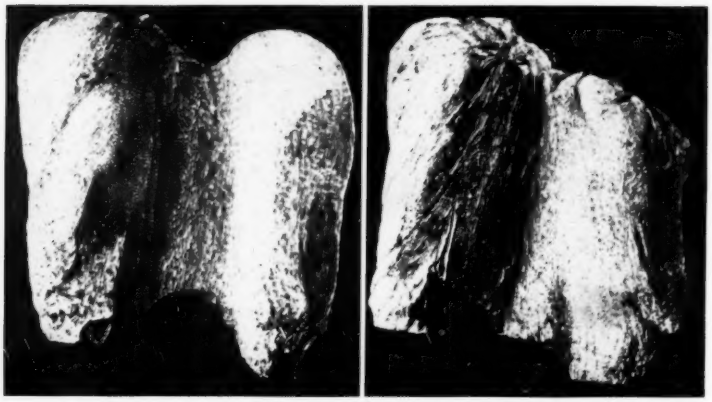

Fig. 8. Plaster cast of renal fossæ in female with bilaterally movable and palpable kidneys. These show shallow cylindrical renal fossæ. They are deeper with the lower end narrower in the dorsal position, shallower with the lower end broader in the vertical position. This is most marked on the right side. (From Wolkow and Delitzin.)

the tension on the vessels by fixation of the kidney either with an abdominal belt or by nephropexy. (Fig. 16.)

Potel and Cordier have shown that the kidney once dislocated can form secondary adhesions between it and the abdominal organs giving rise to secondary gastric, duodenal, biliary, and colic symptoms with the resulting *cachexie néphroptosique*.

Traction of the right movable kidney on the duodenum in some cases may produce dilatation of the stomach. The gastric symptoms resulting from the traction would naturally be increased by upright posture and by lying on the left side, and relieved by the reclining position, particularly with the lower portion of the body elevated or by the proper abdominal support or surgical fixation. Likewise traction or pressure of the prolapsed kidney on the gall ducts may cause biliary ptosis and jaundice. Gallant thinks that movable kidney is a factor in the genesis of bile duct disease. (Fig. 17.)

Fig. 7. Pyelogram of left kidney. Female, age 26 years. *a*, Dorsal; *b*, vertical position. Adhesions due to perinephritic abscess have anchored kidney preventing even normal mobility.

SYMPTOMATOLOGY

Abnormally movable kidneys do not necessarily give rise to marked disturbances as evidenced by the large number without symptoms. Balch and Torbert state that 40 to 80 per cent of all women have a palpable or even movable kidney. The more recent studies of the position of the organs in the abdomen indicate that in the majority of healthy individuals the stomach and colon extend caudad to the interiliac line. The position of the kidneys may be lower than formerly accepted, and it would be interesting to study a large group of healthy women and men to ascertain by pyelography the actual position of the kidneys in the standing posture. However, in a certain percentage of cases it causes hydronephrosis, kinking of the ureter, and

Fig. 9. Female with positive renal index. Long, narrow thorax, thin waist, and relatively increased distance from sternal notch to symphysis pubis. (From Becker and Lennhoff).

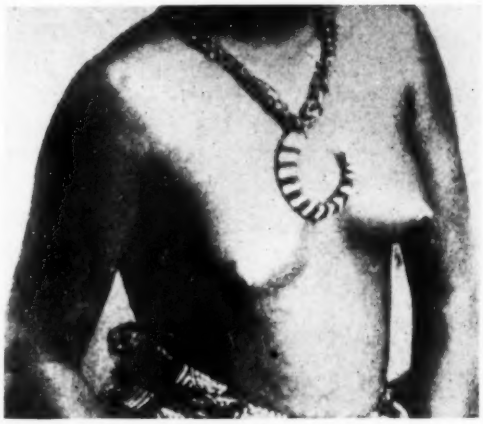

Fig. 10. Female with negative renal index. Short, broad thorax, round abdomen, with relatively decreased distance from sternal notch to symphysis pubis. (From Becker and Lennhoff.)

renal torsion. It is also a factor in the persistence of chronic renal infection, and by producing traction on the stomach, the duodenum, and gall duct, gives rise to definite gastro-intestinal symptoms. The symptoms of the 90 cases studied are given in their order of occurrence. (Table VII.)

The frequency of urological symptoms may be explained by the fact that 56 of the 90 cases were complicated by the more common renal infections. Faulty drainage due to increased mobility was a factor in the persistence of these infections, particularly those caused by the colon bacillus, which made us more energetic in correcting it. Hæmaturia, the importance of which as a symptom was emphasized by Squier in 1911, is interesting because we are likely to connect it with stone or cancer, rather than with movable kidney. It may be caused by congestion of the kidney due to infection or by sudden bending of the ureter, producing sudden back pressure and giving rise to the so-called strangulation symptoms. (Fig. 18.)

The co-existence of appendicitis with movable kidney has been recently emphasized by Cesare, who reported 26 such cases. In these he removed the appendix at the time of the nephropexy through the lower end of the lumbar incision. The so-called appendiceal symptoms are usually due to a co-existing appendicitis. Appendicitis usually causes a distinct type of pain and although one must be careful in distinguishing it from that of

Fig. 11. Pyelogram of right kidney. Male, age 35 years, with negative renal index. Hæmaturia and renal colic followed blow on right lumbar region from 250 pound weight falling 12 feet. *a*, Vertical position. Hydronephrosis and ptosis before operation. *b*, Vertical position. Hydronephrosis diminished and kidney in good position 4 months after operation.

Fig. 12. Pyelogram of right kidney of male patient, age 28 years, with negative renal index. Renal colic followed an automobile accident in which the patient was thrown 25 feet, striking the body in the right lumbar region. Pyelograms made with patient in the dorsal, *a*, and vertical, *b*, positions showing ptosis.

Fig. 13. Pyelogram of left kidney. Female, age 28, showing ptosis of kidney. *a*, Dorsal position; *b*, vertical position. Note that relatively more firmly fixed lower ureter does not sag with kidney. This results in angulation of the ureter at the uppermost point of attachment, usually 1 centimeter above the point of crossing of the ovarian vessels.

movable kidney, it is not reproduced by injecting the renal pelvis. In the 6 cases of appendicitis in the series, removal of the appendix did not relieve the pain due to movable kidney, which later required further treatment.

Stiller, and later Gallant, believed that movable kidney plays a rôle in the genesis of bile duct disease, producing jaundice by traction or pressure on the bile ducts. We have only noted jaundice of short duration and not of great intensity in one of our 90 cases. A number of cases of gall-bladder disease were, however, differentiated from movable kidney and not included in the series.

DIAGNOSIS

The presence of movable kidney can be suspected in an individual with a positive renal index, accompanied by the characteristic group of subjective symptoms noted in Table VII. Palpation of the kidney in the dorsal and standing position should be employed in all cases. It is difficult in very obese patients in whom percussion, although unsatisfactory, may be of some aid. In some cases the lower pole is palpated in inspiration only, in others the lower pole and notch is palpated and the kidney can be retained in the examining hand even during expiration, while in a smaller number of cases the entire kidney can be outlined with a sulcus above the upper pole. (Fig. 19.)

Good plain roentgenograms of the kidney are of great value in determining its position in the dorsal and standing posture and in excluding stone, tumors, and other diseases. The employment of pyelography is invaluable in determining the relative position of the kidneys in the reclining and upright positions, and in giving us a clear picture of the degree of the accompanying hydronephrosis. It often demonstrates that the relatively more fixed lower portion of the ureter does not sag with the kidney, whereas the upper third is more mobile and drops with it, producing a kink in the ureter. There are a number of cases with severe pain that show no kinking of the ureter. In taking the standing picture it is necessary to withdraw the catheter to a point well down in the bony pelvis in order to secure a satisfactory ureterogram. The reproduction

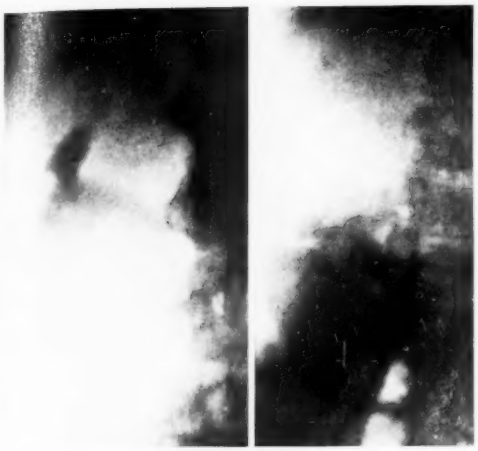

Fig. 14. Pyelogram of right kidney. Female, age 31 years. Acquired renal torsion following ptosis with adhesions. *a*, Vertical position; *b*, dorsal position.

of pain previously experienced by the patient by injecting the renal pelvis is of aid in diagnosis. Unfortunately it is not constant; some cases with fairly well advanced hydronephrosis experience no pain when the pelvis is completely injected. (Fig. 20.)

Catheterization of the ureters and a thorough chemical, bacteriological and functional study of the urine from both kidneys are of great value and were employed in all of this series of cases. It is interesting to note that the function of the prolapsed kidney as determined by phenolsulphonephthalein was sometimes found to exceed that of the more normal opposite kidney. This was usually observed in early cases and was possibly due to irritation, stimulating the kidney to hypersecretion.

TREATMENT

As pointed out before, the vast majority of patients with movable kidney causing no symptoms should be left in happy ignorance of the condition and not be treated at all. However, in those cases in which the undue mobility has caused the peculiar group of symptoms characteristic of this condition, constant or intermittent, infected or non-infected hydronephrosis, with kinking of the ureter, steps should be taken to fix and hold the kidney in place.

Fig. 15. Pyelogram of right kidney. Female, age 42 years. Persistent colon bacillus pyelitis associated with nephroptosis and hydronephrosis. *a*, Vertical; *b*, dorsal position. Note artificial kink produced by catheter in its passage to kidney pelvis. Because of stasis due to faulty drainage, forty-seven renal lavages, five intravenous injections of mercurochrome, 220 soluble, and 12 injections of autogenous vaccine were used before sterile cultures were obtained. This case was treated also with a belt.

One is impressed by the diversified treatment of movable kidney. In a written communication from the Mayo Clinic, H. C. Bumpus states: "Nephropexy is seldom done, preferring rather to bring about the proper position of the kidney by means of abdominal supports, belts. . . . However, in an occasional case this operation has met with success."

From New York, O. S. Lowsley writes:

"My limited experience makes me more enthusiastic than the average surgeon regarding nephropexy. It is my practice to try the belt first and that if it does not relieve the situation to do a nephropexy promising the patient only temporary relief. Only 1 case in about 20 operations has had a recurrence of pain and discomfort. Rarely a belt will relieve the severe symptoms entirely."

From Baltimore, Howard A. Kelly replies:

"Touching the condition of movable kidney, as a rule I believe it is without symptoms, and when there is a double movable kidney, it is practically always associated with visceroptosis. The best

Fig. 16. Pyelogram of right kidney. Female, age 24 years. *a*, Dorsal; *b*, vertical position. The displacement in this case is extreme and is accentuated by secondary adhesions to the adjacent structures. The resulting kink of the ureter persists even in the dorsal position. Patient presented *cachexie néphroptosique*.

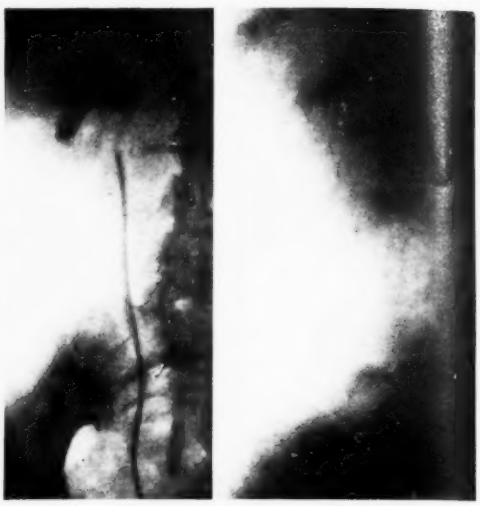

Fig. 17. Pyelogram of right kidney. Obese female, age 47 years; weight 240 pounds. *a*, Dorsal; *b*, vertical position. In the vertical position the kidney has dropped down into the bony pelvis giving rise to repeated attacks of renal colic with marked urinary disturbances. Complete relief followed nephropexy.

treatment for such a condition is without any doubt padding with a suitable binder. When a patient has intermittent attacks of pain in the right side, rather indefinite in character not moderately suggesting either gall bladder or appendix, I believe that in full 80 per cent of such cases the kidney is the organ at fault. This may almost invariably be proved by introduction of catheter and injecting the kidney up to the point of developing uneasiness and then more or less well-defined pain. *A fortiori* can all the cases of marked pain associated with obstruction of the ureter due to kinking be demonstrated with certainty in this way. If the pain is intermittent over longer intervals, the best plan is to put the patient to bed for that and the associated conditions and try to put on fat, at the same time treating the general nervousness and digestive symptoms which are so often associated. When she gets up she should have a suitable bandage. Unfortunately, when the patients are thin, as is so often the case, it is difficult to adjust a pad on the right side which will stick and prove effective. In the more marked cases, those which are persistent, I believe that the method I have adopted for the last 25 years or more, of suspension of the kidney, is almost invariably perfectly satisfactory and gives entire relief. It is a serious loss to surgery and good therapeutics that this beneficent operation has been lost sight of by the profession."

From Chicago, H. Kretschmer writes:

"The experiences of men who have hooked-up kidneys have been very sad in that nephropexy fails to relieve the symptoms. Patients who have a real floating kidney, I put to bed for 2 or 3 weeks and treat with abdominal supports and diets. The occasional case in which the kidney is very movable and produces symptoms we treat with nephropexy. In one of my cases even nephropexy did not give the patient freedom from symptoms."

In Seattle, Peacock employs nephropexy in those cases of orthostatic albuminuria occurring in conjunction with movable kidney except when general ptosis is present.

G. L. Hunner replies with this interesting communication:

"My studies on ureteral stricture in the past 10 years have convinced me that this is the most fertile cause of painful kidneys; whether they remain in place or are prolapsed, and whether they show marked dilatation as one would expect in all cases of stricture with stasis, or whether the pelvis holds less than normal, as is often the case in the most painful type. In general there are two large classes associated with ureteral stricture; first, those that develop large hydronephrosis and hydro-ureter, and the X-ray shows what the urologists have been blaming for this condition, namely, the so-called 'kinks' in the upper portion of the abdominal ureter. As a matter of fact the ureter is as widely dilated below the kinks as above it, showing that there must be some obstruction lower down. And the best proof of the innocuous character of this X-ray kink is that a thorough dilatation of the stricture relieves the patient in most instances. Of course, there may be secondary real kinks or valves between the pelvis and upper ureter, due to the rotation and descensus, or due to inflammatory processes causing binding effects; or these binding or kinking effects may occur

Fig. 18. Pyelogram of right kidney. Female, age 50 years, presenting marked gastro-intestinal symptoms. Kidney in this case remains infected in spite of treatment, because of faulty drainage. Partial relief obtained by belt. *a*, Dorsal; *b*, vertical position.

because the normal attachments of the upper ureter fail to descend with the kidney. In such cases dilatation of the stricture may give great relief to the patient, particularly while in the reclining position, but there may be sufficient symptoms remaining to call for operation or for the rest, bandage, and fattening process to give the kidney a high and more fixed position."

J. J. Bell, in England, reports 300 cases, 200 of which were treated over a period of 15 years with a belt. He states that a belt has never been satisfactory, never has produced a cure, and that if applied with sufficient pressure to do good would ulcerate the skin. In a group of 100 cases treated by nephropexy, of the first 50, 73 per cent were cured, of the second 50, 94 per cent were cured, possibly by using improved technique.

In France nephropexy has been employed for years, notably by Guyon, Albarran, Potel, Cordier, and Papin. Albarran recommended operating upon all cases with complications, with mechanical and painful symptoms, and upon those cases which were not relieved by a belt. In nervous and hysterical cases and in those accompanied by generalized enteroptosis he used the belt and operated only if the symptoms were severe. In Germany many urologists and surgeons favor nephropexy—notably Israel, Klapp and Kleiber, Frangenheim, Kostling, and others.

The treatment may be divided into (1) prophylactic, (2) non-operative, and (3) operative.

Fig. 19. Pyelogram of right kidney. Male, age 22 years, presenting dull, continuous, dragging pain in lumbar region. *a*, Vertical; *b*, dorsal position. Note slight drop and lack of ureteral kinking. Picture in vertical position demonstrates value of taking ureteropyelogram with ureteral catheter well down in bony pelvis.

Prophylactic. Because of the conclusions drawn from the study of the etiology of this condition, that females with the peculiar body form, with shallow cylindrical renal fossæ, wider below than above, are apt to have it and certain prophylactic measures may be taken to prevent it, an all around physical development of the younger generation, consisting particularly in exercises increasing the strength and tone of the abdominal musculature was early advocated by Wolkow and Delitzin as an important measure in preventing nephroptosis. Because of the inferior muscular development in women, pregnancy, and the different mode of living in the two sexes leading to loss of muscle tone in the female, they should not wear tight bands about the lower chest, should keep in a condition of good nourishment and should avoid violent straining exercises. (Fig. 21.)

Non-operative. As early pointed out by Rayer, rest in bed with the lower portion of the bed elevated 32 centimeters, increasing the weight of the patient and the application of well fitting bandages or supports can in many cases give complete relief of all symptoms occasioned by movable kidney. There

is a certain relatively small group of cases, however, in which the symptoms persist in spite of these measures. Potel and Cordier have shown that, after being dislocated, the kidney can form even secondary adhesions between it and the abdominal organs. Figure 16 shows an example of this type that was completely relieved by nephropexy. It would be unsound judgment to expect to elevate an adherent low kidney which has resulted from undue mobility by the use of bandages, fattening, etc. It has been our practice to employ a bandage that brings a pressure from below upward over the entire abdomen. One must bear in mind that the failure of the bandage to fix and hold the kidney in place may be due to an improper bandage or to the use of one otherwise correct, that does not fit. The right bandage is cut and accurately fitted to each patient. The bandage is composed of durable material and takes a firm grip on the abdominal wall from the suprapubic region extending to and including the twelfth rib. It is held down by perineal straps and buckles in front. In addition to this, direct pressure is made under the displaced kidney by another bandage or pad under the larger bandage. Care must be exercised not to imprison the kidney underneath the bandage. Except in the occasional case of an adherent low kidney this can be avoided by putting the belt in place in the horizontal position. The belt is removed at night. It has been our experience that some people greatly dislike the bandage and actually tolerate it with difficulty. This type of patient should be given the choice of surgical suspension. Albarran also gave the choice between operation and bandage in those cases in which the belt had given relief from symptoms.

Rest in bed with the foot of the bed elevated 32 centimeters, is employed particularly during the attacks of severe pain. The patient is sometimes kept in this position for 2 to 4 weeks. In those cases of excrutiating pain with the so-called strangulation symptoms, the dislocated kidney can be reduced by manual manipulation. Fattening in those cases with emaciation and marked gastric symptoms is employed except in the occasional obese individual. Exercises are advised to increase the strength and tone of the inferior relaxed abdominal musculature. If, after a reasonable length of time, varying from 6 months to 1 year the bandages, rest in bed, fattening, strengthening exercises, etc., fail to relieve the symptoms, then one must consider surgical suspension, which was first successfully performed by Hahn. Of the 30 cases in which nephropexy was performed, 14 had experienced little, if any, relief from the use of the above measures. The good results obtained in these cases cause us to reiterate the opinion of Kelly and be more enthusiastic than many surgeons with regard to this particular operation. Again one must not fail to realize that a movable kidney in dropping may cause a kinking of the ureter about an aberrant vessel which can only be relieved by surgical interference. As pointed out before, the faulty drainage of urine with early stasis due to undue mobility of the kidney with kinking of the ureter occurs more frequently than commonly recognized and must be considered as playing a rôle in the persistence of colon bacillus pyelitis. We have seen two such cases of long-standing pyelitis which occurred in movable kidney with kinked ureter requiring among other measures, 47 and 64 repeated renal lavages, respectively, before sterile cultures were obtained. Therefore the fixation of an unduly mobile kidney is not only important for the relief of the symptoms it produces but also in the clearing up of some cases of resistant, chronic, renal infection. (Figs. 22 and 23.)

Operative. In 28 of the 30 cases suspended surgically, the Kelly method of nephropexy was utilized. This consists of three triangular silk sutures devised by M. Broedel, taken in the posterior surface of the kidney with the uppermost attached above the twelfth rib and the two lower sutures to the quadratus lumborum muscle. In addition to this the upper 5 centimeters of the ureter are exposed. If it is found to be bound down by fibrous bands these are carefully dissected away. Aberrant vessels are divided and tied off. The fatty capsule is removed or pushed aside in order not to come between the muscles and the fibrous capsule of the kidney. The anterior and posterior leaves of the perirenal

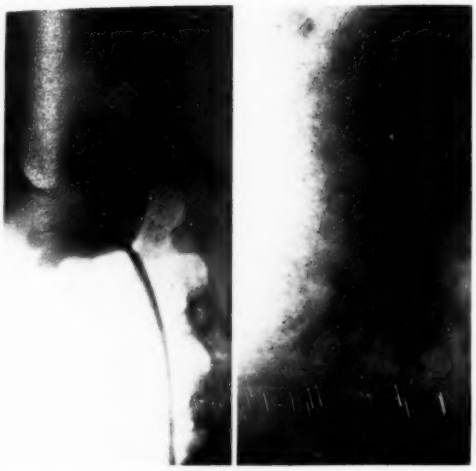

Fig. 20. Pyelogram of right kidney. Female, age 44 years. *a*, Dorsal; *b*, vertical position. Although there is a fairly well developed hydronephrosis following ptosis, injection of renal pelvis failed to produce any pain. Reproduction of pain by injection, although a valuable aid in diagnosis, is not always constant and in advanced cases may be absent.

Fig. 21. Pyelogram of right kidney. Female, age 39 years. Complete relief from symptoms was obtained by abdominal support, fattening, strengthening exercises, etc. *a*, Dorsal; *b*, vertical position.

fascia are brought together below the lower pole of the kidney and anchored to the quadratus lumborum muscle and the peritoneum if necessary. Care must be taken in all cases not to include nor injure the first lumbar nerve. In the remaining two the method described by Klapp and Kleiber was employed. This consists of catching the renal fascia from below, upward, with gathering closing sutures, bringing the kidney higher and higher into the renal fossa. In this way the prerenal and retrorenal fascia which do not come together below the kidney but rather are lost in the fatty tissue of the iliac fossa, are brought together, sutured to the quadratus lumborum, and peritoneum, if necessary, making a sort of sling or bed for the kidney to rest upon. In all cases we attempted to draw the kidney well up in the renal fossa, suspending it to the twelfth rib. There was an occasional case, however, in which because of the shallowness of the renal fossa it was impossible to do this and the kidney was anchored to the quadratus lumborum or the fascial operation performed. It has been our practice to keep the patient in bed 3 weeks after the operation, lying on the side operated upon with the foot of the bed elevated 32 centimeters. In this way firm adhesions of the kidney to the posterior abdominal wall are more likely to occur. In two cases both kidneys gave persistent symptoms and both were suspended giving good results. Although it has often been stated that nephropexy fails to relieve the symptoms of movable kidney the literature gives us accounts of repeated cases and groups of cases in which it has given complete relief. Surgical suspension has failed in many cases because it has often been performed where it has not been indicated, on the common, harmless type of movable kidney which causes no symptoms, on cases in which general visceroptosis, gall-bladder disease, or other abdominal lesion obtained, and on nervous hysterical types without first trying supporting measures. When the diagnosis has been correct, failure has been due to faulty surgical technique or to the presence of a co-existing cause of back pressure, such as ureteral stone, fibrous bands, and stricture or kink of the ureter unrelieved at the time of operation. Recurrence has occurred as evidenced by the great number of operations that have been devised for the support of the kidney. In the hands of Kelly, Hinman,

Fig. 22. Pyelogram of right kidney. Female, age 24 years. In spite of abdominal support, gastro-intestinal and urinary symptoms occasioned by movable kidney have recurred. Patient has failed to increase in weight. Surgical suspension is being considered.

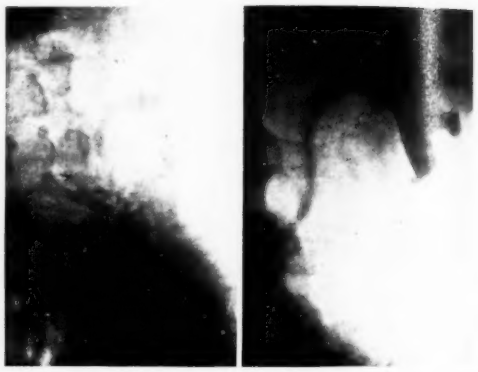

Fig. 23. Pyelogram of left kidney. Male, age 40 years, with repeated attacks of severe renal colic over a period of a year. Complete relief following operation. *a*, Vertical position before operation; *b*, same position after operation.

Lowsley, Peacock, Potel and Cordier, and Klapp and Kleiber, when improved technique was used the results have been very good. It is interesting to note in passing that J. J. Bell, in performing one hundred consecutive nephropexies reports 73 per cent cures of the first 50, and 94 per cent cures of the second 50. He attributes this greater percentage of cures in the second 50 cases to improved technique. (Table VIII.)

TABLE VII.—FREQUENCY OF SYMPTOMS

	Cases
Pain	
Dull continuous, dragging pain in the lumbar region	47
Intermittent sharp pain in the lumbar region radiating along course of ureter to labia, testis, or thigh	43
Urological symptoms	
Frequency of urination	64
Nycturia	44
Burning urination	33
Hæmaturia	16
Acute retention of urine	3
Incontinence of urine	1
Gastro-intestinal symptoms	
Nausea	43
Gas	35
Constipation	24
Hyperacidity	18
Vomiting	18
Co-existence with appendicial symptoms	6
Diarrhœa	4
Mucous colitis	1
Other symptoms	
Loss of weight	30
Nervous symptoms	29
Inability to work without fatigue	26
Tumefaction in upper abdominal quadrant	3
Jaundice	1

RESULTS

The results obtained from the use of belts were particularly good when the symptoms had been present for but a short while, and the lumbar pain was of the milder dull, dragging, constant type. In the more chronic type of repeated attacks of severe Dietl's crises in which adhesions had in some cases formed around the prolapsed kidney, in which kinks developed in the ureter due to fibrous bands or aberrant vessels, belts afforded slight, if any, relief. Of the 30 cases operated on 14 had worn belts for a period of time varying from 6 months to 1 year with no appreciable relief. One, a school girl of 17, was obliged to remain out of school for 1 year because of repeated attacks of pain. Likewise a bookkeeper was kept from working for 6 months. These cases were later relieved by surgical suspension.

Two cases suspended surgically were unrelieved. This was due, in one, to the fascial operation failing to hold the kidney in place

TABLE VIII.—RESULTS

Abdominal Supports	Cases	*Nephropexy*	Cases
Relieved	31		25
Greatly relieved	5		1
Slightly relieved	7		2
Unimproved	10		2
Not followed	7		0
Total	60		30

as was demonstrated later by a pyelogram, and in the other to the development of a pyonephrosis in an already badly infected movable kidney.

SUMMARY

The great majority of movable kidneys cause no symptoms and require no treatment. In a certain percentage of cases, however, renal mobility forms a definite clinical entity characterized by lumbar pain, urinary, gastro-intestinal, and nervous disturbances, loss of weight, etc., and require fixation by abdominal support or surgical intervention.

2. The condition is more common in the female because the renal fossæ are shallower, cylindrical or even funnel shaped, being wider below than above. This predisposition to displacement is increased at puberty because of the widening of the bony pelvis. In males the renal fossæ are pear-shaped, being narrower below.

3. Its greater frequency on the right side is due to the shape of the renal fossa, the presence of the liver on that side, and the weaker support afforded by the less well developed right perirenal fascia.

4. The majority of cases of renal ptosis can be relieved by the proper abdominal support, fattening, and strengthening exercises.

5. Nephropexy is a justifiable operation. It has been employed by numerous urologists of note who have found it satisfactory. It relieves symptoms and is indicated in the following cases of movable kidney: (a) when the belt fails or is poorly tolerated; (b) in those cases complicated by ureteral kink caused by fibrous bands; (c) when the sag of the kidney has caused the ureter to kink over an aberrant vessel; (d) in those cases in which adhesions have developed around a prolapsed kidney holding it in place; (e) in chronic colon pyelitis when faulty drainage due to increased mobility is not corrected by the belt.

6. We have employed nephropexy with success in 96 per cent of the 30 cases operated on. Of those, 46 per cent had obtained no relief from mechanical supports although they had been employed for some time, varying from 6 months to 1 year.

7. A review of the literature leads us to believe that surgical suspension has fallen into disrepute, not on account of its inefficacy, but because it has been performed when it has not been indicated, the technique has been faulty, or there has been failure to realize the necessity of exposing the ureter and relieving any condition which might be present, which unrelieved, would defeat the purpose of the operation.

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A SUCCESSFUL CARDIORRHAPHY[1]

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WOUNDS of the heart are most frequently caused by stab wounds and gunshot wounds, and it is surprising to know how complicated such wounds may be in regard to injury of the other organs in the thorax and the abdominal cavity. Complicating heart wounds we frequently see, wounds of the pleura, of the aorta, of the coronary artery, of the internal mammary artery, of the diaphragm, and of the various abdominal organs. The pericardium must needs be penetrated although, according to observers, it may escape injury by being pushed inward by the traumatizing agent causing the injury to the heart.

According to the authorities which we have at hand and the view that is held now by many surgeons, hæmorrhage *per se* is not the cause of death in wounds of the heart. A wound of the heart does not cause the victim to bleed to death. When such a wound occurs, blood fills up the pericardial sac, intrapericardial tension or choking occurs, and the heart action is interfered with. This is known as hæmopericardium or "heart tamponade." Pressure is mostly exerted on the thin-walled auricle as well as the large veins, so that the flow of blood to the ventricles is eventually stopped and the ventricles pump themselves dry. It also causes direct pressure against the movements of the ventricles and these contractions are finally stopped. Heart tamponade then is the real cause of death and not the amount of bleeding nor the wound in the heart itself.

Da Costa (2) in his last edition of *Modern Surgery* states: "Rosenthal, Block, Del Vecchio and others proved by vivisectional experiments that wounds of the heart are not of necessity instantly fatal, that in some cases they may be recovered from, that the suturing of such wounds is possible and that suturing greatly enhances the chance of recovery."

In the *Annals of Anatomy and Surgery*, December, 1881, John B. Roberts of Philadelphia first suggested that it would be rational to attempt suture of wounds of the heart.

In 1887 Cincinnati's famous surgeon, Reed, sutured a wound of the pericardium and the patient recovered.

In 1891, Dalton of St. Louis performed a similar operation and the patient recovered. To Farina of Rome goes the credit of being the first to suture the human heart. The wound was a stab wound of the right ventricle but, unfortunately, the patient died on the sixth day of pneumonia. In 1896 Rehn of Frankfort performed the first successful cardiorrhaphy. After suturing, he packed the pericardial cavity with iodoform gauze.

Poole (5) states that the soundness of immediate surgical treatment for wounds of the heart has been thoroughly established after 25 years of relatively good and constantly improving results. Even in suspected cases, when the diagnosis is probable but not positive, exploratory operation is entirely justifiable and is an approved procedure. E. Hesse and Foederl (quoted by Poole) emphasize this point for the following reasons:

1. There is no typical clinical picture whereby a wounded heart can always be diagnosed especially in the first few hours after an injury. The classical syndrome of heart tamponade, due to intrapericardial pressure, is more often absent than present. Physical signs in the cardiac region such as abnormal sounds and increased dulness are frequently inconclusive, the position and direction of the surface wound are not always convincing, while the suggestive symptoms of internal hæmorrhage, hæmothorax or hæmopneumo-thorax may originate entirely in the thoracic lesions other than heart injury.

2. It has been shown by statistics that the prognosis by reason of hæmorrhage and shock becomes progressively worse as the interval between the trauma and the operation lengthens. Therefore, although delay in some cases will render the diagnosis certain, postponement of operation until dangerous symptoms

[1] Read before Medical Society of South Carolina, May 27, 1924.

make their appearance is not to be recommended.

Travers' case (6) of injury to the heart quoted by Peck (4) confirms the view that the human heart has great powers of resistance: "A young man, 19 years of age, was impaled on an iron picket fence. The sternum was fractured and the right ventricle wounded, the heart wound being plugged with a fragment of bone. Terrific bleeding through the extensive tear in the heart wall followed the removal of the fragment of bone, the hæmorrhage being temporarily checked by three fingers passed through the wound into the cavity of the ventricle. Twenty-three stitches (in two tiers) were used in closing the 2½ inch wound in the ventricular wall and the patient lived more than 10 days, death occurring from slow secondary hæmorrhage into the pericardium due to imperfect healing of the contused and lacerated wound edges and not from sepsis. This was probably the most extensive heart wound ever sutured with even temporary success."

Certain and rapid healing of sutured heart wounds may be definitely looked for according to Peck (4) if death from hæmorrhage or shock is averted and septic infection prevented. Elsberg (3) has shown that repair takes place as in other muscles by the formation of fibrous tissue and not by regeneration of heart muscle, but that it is none the less strong and the function of the heart muscle is not seriously impaired.

Statistics show that the majority of patients with heart wounds (about 65 per cent) die of infection, empyema, infective pericarditis, sepsis on the ninth or tenth day. Hence, we should be extremely careful in our preparation of the skin, notwithstanding the fact that we are facing a real emergency demanding celerity. We should, as speedily as possible, disinfect and sterilize the skin with our usual skin antiseptic while the patient is being anæsthetized. It is a wise precaution also to excise the edges of the stab wound as infection may lurk there.

George Tully Vaughan (7) in reporting his second case of heart suture and a table of 150 operations, mentions 5 methods for exposing the heart and states that no single method has yet been agreed on as the best. The character and location of the external wound frequently determines the kind of operation and the subsequent steps depend on the necessities arising during its progress. Vaughan's 5 methods are: (1) incision through an intercostal space with or without the division of one or two cartilages; (2) resection of one or more cartilages with or without a portion of a rib; (3) flap across the sternum, dividing the sternum and cartilages; (4) flap of cartilages and ribs with external hinge; (5) flap of cartilages and ribs with internal hinge.

The question of drainage in these cases is an important one. I believe that undoubtedly the use of drainage tubes has tended toward infection if not actually caused it. If we can feel reasonably sure of our skin preparation and sterilization, I would be inclined to suture both pericardium and pleura without drainage. Some surgeons, however, prefer to drain the pleura if it has been opened and the best procedure here is to resect a rib posteriorly as in empyema and insert the drainage tube here rather than in the original anterior wound.

The mortality in cardiorrhaphies is still high. Some observers have placed the mortality at 50 per cent. Constantini (1), for instance, gathered 281 cases in which operations for wounds of the heart had been performed with a total of 140 deaths, a mortality of about 50 per cent. But I am of the opinion that this percentage is too low and does not represent consecutive cases. Most surgeons are apt to report their successful cases and no mention is made of their unsuccessful ones. I would say that a great number of heart wounds unsuccessfully operated upon are never published. If these were published the mortality naturally would be higher. A fair estimate of cardiorrhaphies would be about 65 per cent mortality. There is no doubt, however, but that the prognosis in these cases has improved and it will continue to improve so long as we are careful in our pre-operative technique so as to prevent subsequent infection and so long as we are bold enough to open the chest early and prevent a fatal heart tamponade.

There was admitted to Roper Hospital on the afternoon of April 14, 1924, at 7:30 p.m. a negro

youth, E. F., 18 years of age, with a stab wound of the chest. He gave the following history: About 15 or 20 minutes before admission he had been in a fight with another negro and had been stabbed by him. The fight occurred on Logan Street near Broad and the patient rode a bicycle to the hospital, a distance of about ¾ mile, after the infliction of the injury. He walked to the emergency room and there fell down in a faint. His pulse at this time, according to the interne, was very poor and almost imperceptible. He was taken immediately to the operating room because the interne felt reasonably certain that some serious wound of the chest, with internal hæmorrhage, had taken place.

On my arrival at the hospital about 8 p.m. I found that the patient had improved somewhat from his condition in the emergency room. His pulse was 118, of fair quality, respirations about 28 and skin fairly warm. I could not, at this time, conclude that any serious wound of the chest existed. There was a stab wound just over the sternum about ⅜ inch in length at about the level of the fifth rib. On pressure we could get a drop or two of blood. There was no increase of heart dulness which would point to blood in the pericardium and the heart sounds were neither distant nor muffled. In fact, the heart sounds were remarkably clear and distinct. I ordered the patient to remain in the operating room and stated that I would see him again in a little while. I could not bring myself to believe, at this time, that this boy had a wound of his heart.

I returned to the patient at 9 p.m. and found an entirely different picture. He was cold and clammy, his respirations were rapid and shallow and, occasionally, sighing. His pulse was imperceptible and blood pressure 78—50. My diagnosis now was that he had a serious intrathoracic hæmorrhage and very probably a wound of his heart. I decided to operate at once.

After the patient had been anæsthetized with ether and the skin rapidly but thoroughly sterilized, I made a longitudinal incision over the sternum about 6 inches in length and including the original wound. Two flaps were turned back. I resected about 2 inches of the fifth rib on the left side and placed in retractors but found that this opening was totally inadequate. I could, however, see that some serious hæmorrhage was occurring, most probably in the pericardium. I cut across the sternum and freed it on the right side, pulled it up forcibly and fractured it, intending to perform an osteoplastic operation. However, the sternum kept constantly escaping from under the retractor and I finally excised its middle third. In doing this, the pleura, on the right side, was torn into. I quickly ligated the internal mammary artery. I now had a very clear exposé of the pericardium and I noted the wound therein. I quickly enlarged the opening in the pericardium and found, after quickly sponging the sac, a wound in the right auricle through which a steady, uninterrupted stream of blood was coming about the size of an ordinary lead pencil. I quickly placed a suture of chromic gut No. 1 on a Mayo needle through the upper angle of the wound and tied, leaving one end long so as to steady the heart. I put in my second suture and I believe this would have been sufficient to have closed the opening and stopped the bleeding, save for the fact that I punctured a vein between the auricle and ventricle and I was compelled to put in two additional sutures to control this. The pericardium was wiped dry and sutured with chromic gut No. 1, continuous. The torn pleura was also sutured with chromic gut No. 1. A ½ inch rubber tube was placed down to the sutured pericardium but not in it. The skin was sutured with silkworm-gut.

He was returned to the ward in poor condition and with little hope of his recovery. His brother, who was waiting in the hospital, offered to give his blood for a transfusion and this was immediately arranged, not doing the Wassermann. He was given 500 cubic centimeters of citrated blood about 1 hour after the operation. He had a rather stormy convalescence with very rapid pulse (140–160) and rapid respiration (40–60) for a few days.

On the fourth day the drainage tube was removed and on the ninth day the sutures were removed and a copious amount of serum escaped from just under the skin.

From April 28 to May 5 marked dulness was noted in his right chest posteriorly which caused me to suspect pneumonia but on the latter date 360 cubic centimeters of clear serum was withdrawn by aspiration. Again on May 11 the dulness was still noted and again the chest was aspirated with the result that 360 cubic centimeters of serum was withdrawn.

At present the patient has no complaints. His respirations and temperature are normal and pulse is slightly above normal. On exertion around the ward, his pulse rate is accelerated to 88–96. His usual pulse rate now is 82. We can detect no abnormal cardiac sounds, not even a pericardial rub, and it will be interesting to watch the future course of this patient.

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DRAINAGE OF THE THORACIC DUCT IN PERITONITIS[1]

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THE purpose of this experimental work was to ascertain what relief drainage of the thoracic duct afforded patients with peritonitis. Previous work had seemed to show its value, and I had been led to believe that with this new weapon added to the armamentarium of the surgeon, peritonitis would no longer be the menace it had been in the past.

Drainage of the thoracic duct in cases of peritonitis is, of course, based on the assumption that in peritonitis the toxins and bacteria which are death-bearing reach the circulation through this duct. If only an insignificant number of such bacteria and toxins come through the thoracic duct, then their elimination would not be worth the cost in vital energy to the patient, of an operation which in itself carries a slight amount of shock and which later robs him of nourishment. In view of this, I attempted to ascertain experimentally: (1) whether bacteria which are injected into the peritoneal cavity in cases of peritonitis can be recovered from the thoracic duct; (2) whether the fluid from the thoracic duct in such cases is toxic; and (3) whether animals having peritonitis are benefited by lymphaticostomy.

It is possibly true that, in cases of peritonitis, absorption determines the life or death of the patient. Many fluids and substances have been injected into the peritoneal cavity to determine the route of absorption therefrom; for example, physiologic salt solution, soluble dyes, colloidal silver, lampblack, bacteria, milk, Chinese ink, blood, oil, and egg-yolk. Studies of the anatomy of the thoracic duct abound in the literature, and wide variations in structure are noted, a knowledge of which is essential to anyone contemplating drainage of the thoracic duct for peritonitis. The literature on experimental ligation or drainage of the thoracic duct in normal animals covers two centuries. The results reported are various, and opinions as to its effect, conflicting. Many observers report deaths following ligation or drainage of the duct in previously normal animals; these deaths may have been due to infection. Even with modern technique an occasional infection must be anticipated.

METHOD OF EXPERIMENTATION

Dogs were used for the production of fistulæ of the thoracic duct. Rabbits were used to test the toxicity of the fluid obtained from the thoracic duct. Ether anæsthesia was used in all experiments requiring operative procedures. Operative sites were shaved, thoroughly iodized, and draped with sterile towels and sheets. Sterile operating procedures were carried on with the aid of two sterile nurses. The technique for the production of the thoracic duct fistulæ was that employed in the Institute of Experimental Surgery, The Mayo Foundation (48). The experiments have been divided into four groups:

Group 1. Twenty-four hour cultures of bacillus prodigiosus were diluted in 50 cubic centimeters of physiologic salt solution, and injected into the normal peritoneal cavity of each of 6 dogs, after the thoracic duct fistula had been established and was draining freely. All of the lymph that drained from the thoracic duct over a 5-hour period from the time of the injection was collected and cultured for bacillus prodigiosus. Cultures were made on broth, agar plates, and dextrose agar, and allowed to incubate for 36 hours and then to stand in sunlight. There were 3 reasons why bacillus prodigiosus was particularly adapted for this work: (1) bacillus prodigiosus is a non-pathogenic organism; (2) it is easily identified, forming reddish colonies when exposed to sunlight, and (3) it is an organism not common around the laboratory, which minimized the likelihood of contaminating the cultures. Cultures from 5 were negative. Only 1 was positive for bacillus prodigiosus. In 1 case blood cultures taken 1, 2, and 3 hours after the bacillus prodigiosus was injected into the peritoneal cavity were negative.

[1]Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, March, 1924. Work done in the Division of Experimental Surgery and Pathology, the Mayo Foundation.

Group 2. Trauma to the peritoneal surface was considered as a possible factor in the absorption therefrom. Accordingly, the peritoneum of a dog was traumatized by rubbing the peritoneum, both parietal and visceral, with dry gauze, by bringing the intestines outside the abdomen and exposing them to the air for several minutes, and by applying very hot packs soaked in salt solution to them. By these means a definite ileus was produced. Forty-eight hours later a thoracic duct fistula was produced by the technique previously described. A 24-hour culture of bacillus prodigiosus diluted with 50 cubic centimeters of physiologic salt solution was then introduced into the peritoneal cavity of the dog under aseptic precautions. Cultures from the thoracic duct continuously for 5 hours, and again after 24 hours, were negative for the bacillus. It seemed then that trauma did not materially hasten absorption from the peritoneal cavity through the thoracic duct.

Group 3. Little has been definitely determined as to the alteration of absorption from the peritoneal cavity in cases of peritonitis. It was thought that absorption through the thoracic duct might be easily demonstrated in cases of peritonitis, even though not demonstrable from the normal peritoneal cavity. Accordingly, peritonitis was produced in 8 dogs. At first, peritonitis was allowed to develop by opening the sigmoid, and allowing a small amount of contamination to occur therefrom; the sigmoid was then carefully closed. However, the micro-organisms in the sigmoid were too virulent for this work, for when the lymphaticostomy was attempted 24 to 48 hours later, the dogs were moribund, and we lost 3 under the first few whiffs of ether given to perform the lymphaticostomy. A less virulent degree of peritonitis was obtained by opening the jejunum, allowing contamination to occur, and then carefully closing it. After 24 to 48 hours a lymphaticostomy was performed. Bacillus prodigiosus was then injected into the peritoneal cavity of each of these dogs, and cultures made for 5 hours from the thoracic duct, then cultured on broth, dextrose agar, and agar plates. The cultures were incubated for 36 hours and then allowed to stand in the sunlight for 36 hours; cultures were negative for bacillus prodigiosus. More important still, the dogs all died, and necropsy showed that they had died of peritonitis.

Group 4. Toxins from the peritoneal cavity might be assumed to reach the circulation through the thoracic duct, even though a definite organism could not be injected into the peritoneal cavity and recovered from the duct. It was determined, therefore, to test the toxicity of lymph obtained from fistulæ of the thoracic duct of dogs with peritonitis. This toxicity could best be determined by injecting it into the circulation of a small laboratory animal and noting its effect. Small rabbits weighing about 800 grams were chosen for this purpose. A series of normal controls was first watched. Four normal dogs were used for this series.

Thoracic duct fistulæ were produced in the 4 dogs, and lymph was collected in sterile test-tubes containing a small amount of sodium citrate solution to prevent coagulation. Body temperature was preserved by keeping the test tubes in a waterbath. The lymph was then injected into the vein of a rabbit's ear in amounts varying from 1 to 12 cubic centimeters at one injection. No effect whatever was noted on any of the rabbits.

Lymph from the thoracic duct of 1 dog with experimentally produced ileus was injected into the vein of a rabbit's ear in amounts up to 8 cubic centimeters. No effect was noted, although the ileus proved sufficiently severe to cause the dog's death in 48 hours.

Having ascertained that lymph from a normal dog, and lymph from a dog with experimentally produced ileus had no apparent effect on rabbits when injected intravenously, the effect of lymph from dogs with peritonitis was investigated. Eight dogs with experimentally produced peritonitis and fistulæ of the thoracic duct were used for this purpose. Lymph was collected under sterile precautions as in previous experiments, kept at body heat in a waterbath, prevented from coagulation by the use of sodium citrate solution, and injected intravenously into rabbits. From 8 to 25 cubic centimeters were injected at one injection, 13

cubic centimeters being the average. No effect whatever was noted in 7 cases. One rabbit, however, did have a reaction. It had been previously subjected to several injections in amounts varying from 8 to 15 cubic centimeters with no effect. Twenty-five cubic centimeters of lymph was finally injected in about 1 minute, and the rabbit immediately had a severe tonic convulsion, followed by clonic convulsions, inhibition of sphincters, and cessation of respiration. The rabbit appeared dead for about 1 minute, except that a faint heart-beat could be palpated. Then shallow respirations commenced, slow movements returned, and in 3 minutes the rabbit again appeared normal. He died a week later from an intercurrent infection. I am not certain what caused the peculiar reaction in this rabbit, but it appeared to be an anaphylactic reaction. It occurred after injecting rapidly 25 cubic centimeters of lymph, which was the largest single injection. It might have been due to fat emboli. At any event it did not appear to bear any relation to a possible toxin in the lymph of the animal with peritonitis.

DISCUSSION

The great dissimilarity of views and the conflict in findings and conclusions of various observers is striking. That there is absorption from the peritoneal cavity directly into the subperitoneal capillaries there can be little doubt after reading the work of Starling and Tubby, Hamburger, Orlow, Dandy and Rowntree, Clark, Bolton, and Putnam. The omentum, too, seems to play a part, as is shown by the researches of Durham, Buxton and Torrey, Thiele and Embleton, and Shipley and Cunningham.

Lymphatic drainage from the peritoneal cavity, through the diaphragmatic lymphatics and thence to the anterior mediastinal lymph nodes, is shown from the work of Muscatello, Durham, MacCallum, Buxton and Torrey, and Cunningham. Beck and Thiele and Embleton find absorption through the thoracic duct. Costain considers absorption of the thoracic duct the important factor. My own work does not substantiate this. Costain assumed that all dogs in which the meso-appendix and base of the appendix are tied off will die from peritonitis secondary to a gangrenous appendix, if no procedure to aid them is undertaken. Williamson, working in this laboratory at the Clinic, obtained very different results. He tied off the meso-appendix and stump of the appendix in 4 dogs, and found that 2 lived, even though nothing was done to relieve them. Rost, and Buxton and Torrey believe that there is an increased phagocytosis in the exudate of peritonitis which engulfs many organisms. Rost also states that the peritoneal fluid has the power to clump and dissolve, and that the leucocytes and the endothelial cells produce agglutinins, precipitins, and bacteriolysins. Bolton, after some very exhaustive experiments decided that the lymphatic route through the right lymphatic duct was much more important in the drainage of the peritoneal cavity than that through the thoracic duct. All this is very confusing, and one wonders which avenue is the important one.

My experiments would seem to minimize the importance of the thoracic duct in drainage of the peritoneal cavity. I was unable, except in 1 case, to recover bacillus prodigiosus from the lymph of the thoracic duct after injecting it into the normal peritoneal cavity, and not once in dogs having peritonitis. It must be admitted, however, that the bacteria could possibly have been killed in the peritoneal cavity which would account for the negative cultures of the lymph. However, the lymph from the thoracic duct in cases of peritonitis was not toxic to small laboratory animals. And, finally, dogs with peritonitis did not seem to be benefited in the least by drainage of the thoracic duct as they all died. It is possible, but not proved, that certain types of bacteria or toxins do pass into the lymph, in which case lymphaticostomy might be beneficial.

In connection with drainage of the thoracic duct for peritonitis, I wish also to call attention to the great variety of thoracic ducts; its frequent anomalies; its variety and often multiplicity of terminations, sometimes on the right and sometimes on the left; its frequent anastomoses with blood vessels in the chest, and its extensive anastomoses, often with the right lymphatic duct. All

these factors bear on the advisability of draining the thoracic duct to secure drainage in peritonitis. Many former workers also found that previously normal animals frequently died following lymphaticostomy. These deaths may have been due to infection, and we may still expect an occasional death from infection. The thoracic duct has been drained for peritonitis in this clinic twice (1923), but both patients died from peritonitis with no apparent change in the course of the disease following the lymphaticostomy.

CONCLUSIONS

1. Bacillus prodigiosus, injected intraperitoneally in cases of experimentally produced peritonitis, could not be recovered from lymph from the thoracic duct.

2. Lymph from the thoracic duct in cases of peritonitis in dogs did not appear highly toxic, comparatively large amounts producing no effect when injected intravenously in rabbits.

3. Dogs with experimentally produced peritonitis were not benefited by drainage of the thoracic duct. All of them died.

4. Much experimental work must still be done before surgeons may perform with confidence lymphaticostomy in cases of peritonitis.

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SURGICAL COMPLICATIONS OF DIABETES UNDER INSULIN TREATMENT

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THE reluctance of the surgeon to operate on patients with diabetes has been due to the fear of coma and of the difficulties of wound healing. Much had been accomplished by the practice of undernutrition and a proper regard for the limits of safety as shown by blood chemistry. Now, after a widespread trial of insulin, it may fairly be said that by its use, supplementing dietary regulation, the surgical hazards peculiar to diabetes have been overcome. But this statement holds true only when due consideration is given to the metabolic abnormalities which are present, or potential, in diabetes and its complications, and only when painstaking attention is paid to the management of the individual patient. In this brief discussion of principles and procedure, presented from the internist's point of view, it will be obvious how important are the surgeon's judgment and technique, his choice of operation and anæsthetic and how much we rely on the accurate control of our treatment furnished by diet kitchen and clinical laboratory.

From a practical standpoint, the surgical conditions which demand operation in the diabetic may be divided into two groups: (1) those which are accompanied by infection, and (2) those in which infection, or sepsis, is absent. The latter group of patients, who, for example, require the removal of tonsils, an enlarged prostate, a uterine tumor, may be considered to present the usual problems of diabetic treatment, with a time allowance sufficient for conservative preparation. These patients, other things being equal, may be expected to have an uneventful course.

In the first group, the patients who come with the complication of infection, there are frequently presented the most difficult problems of diabetic treatment, over and above the surgical condition, which, like gangrene or appendicitis, may be grave or urgent. It is the unexplained diminution of the ability of the body to utilize carbohydrate which is the disturbing factor introduced by infection. This loss in tolerance is directly associated with the failure of insulin, in greater or less degree, to play its rôle in the conversion of glucose in the body to an assimilable form. Normally adequate insulin dosage becomes insufficient, and relatively enormous amounts may be given with small effect. The consequent failure of the body to burn sugar is followed inevitably by faulty combustion of fat supplied from the body stores if not by the diet. When ketosis comes with infection, coma is not far behind.

Under these circumstances, it is a fortunate patient whose source of infection can simply and speedily be eliminated. By the incision of an abscess or carbuncle under novocain, or the removal of an appendix under gas and oxygen anæsthesia, a mild diabetes, which by reason of the infection has become severe and even life-threatening, may be reconverted to its former benign state. That is to say, insulin regains its power, and the vicious metabolic circle is broken. Therefore, surgery not only is not contra-indicated, but may be the essential foundation of good diabetic therapy. Even in the more serious cases, experience would seem to forbid too long a pre-operative delay, and to indicate that the safer procedure is an early operation, and then, with the factor

of infection out of the way, the vigorous use of insulin.

With these general considerations in mind, we may turn to the methods of their application to the patient. These may be discussed under the heads of diet, of insulin dosage, and of laboratory control, all so closely interrelated that one cannot be considered without the others.

Insulin permits a wide latitude of bodily nutrition, but it has been our aim to combine the undoubted benefits of a plan of undernutrition with the conservative use of the pancreatic extract (1). In the presence of surgical complications, we take no liberties with high fat ratios however helpful they may be in diets under other circumstances, and adhere to a proportion of fatty acid to glucose, expressed in grams, not greater than 1.5:1 (2). Temporarily, before operation and immediately after, the carbohydrate may be raised much higher, with a corresponding increase in insulin in order to dispose of acidosis promptly. From the start, protein is usually given in the proportion of one gram per kilogram of normal body weight.

Since glycosuria and ketonuria disappear, under favorable conditions, within 48 hours after an adequate régime of diet and insulin has been established, we come to rely on blood chemistry as the guide to treatment. Notwithstanding the support of insulin, we strive to have at time of operation, if gas-oxygen is to be used (and we have avoided all other general anæsthetics), the blood sugar below 0.35 per cent and the carbon dioxide combining power above 40 volumes per cent (3). It is not unusual, even after a relatively brief anæsthesia, to find a depression of 15 to 20 volumes per cent in the combining power, so that this determination, when there is any question of acidosis, becomes of great importance. When local anæsthesia is employed, these margins of safety may perhaps be extended, but it is as well to remember the possible toxic effects of the unburned sugar and fats, especially on heart muscle and peripheral circulation, and impose no avoidable burden during a time of stress.

Perhaps the only general rule for the use of insulin that may be laid down, is to give a quantity sufficient to keep the blood sugar within normal limits, or, for practical purposes, between 0.1 and 0.18 per cent. By remaining above the lower margin, hypoglycæmia will be avoided, while the proper healing of wounds in the diabetic would seem to hinge on the maintenance of blood sugar below the level of hyperglycæmia. It has been convincingly shown that in tissue cultures the presence of an excess of glucose in the medium was followed by degeneration and death of the growing cells (4), and the confirmation of this fact of cellular physiology by clinical observation is unmistakable.

Without a period of trial, it is impossible to predict the effect of the insulin unit on blood sugar or glycosuria in the individual patient. One or two grams of sugar in the urine, and 10 milligrams per 100 cubic centimeters of blood are commonly accounted for per insulin unit in an uncomplicated case. But at the other extreme, under the influence of infection, or some other anomaly of metabolism, 50 units may be required to reduce blood sugar by 150 milligrams. In practice, it is our method to hold the diet constant or even reduce it by degrees, while studying the effect of increasing doses of insulin on the blood sugar. When this has once been lowered to normal, we feel that firm ground is beneath our feet. Subsequent blood sugar determinations will tell us whether the balance is being maintained, and will guide us in respect to necessary increases in food intake, the return of carbohydrate tolerance, and the need for insulin.

The case reports which follow illustrate some of the typical problems of diabetics with surgical conditions.

CASE 1. Obesity and mild diabetes. Abscess of knee, with temporary marked loss of tolerance. Rapid healing with insulin.

C. H., male, age 57, Danish, was referred by Dr. E. M. Foote, after finding 5 per cent sugar in the urine, when the patient presented himself for the treatment of varicose eczema of the legs. The diet was restricted and on admission to the Polyclinic Hospital on November 28, there was 1.4 per cent sugar, with no acetone or diacetic acid in the urine. The blood sugar was 0.20 per cent and the carbon-dioxide combining power was 60 volumes per cent. The patient was 5 feet 9½ inches in height, weight 261 pounds. The general physical examination was negative, and the blood pressure was 110-80. Over

both legs was a chronic varicose eczema, with a few small areas of ulceration.

On a diet of 75 grams carbohydrate, 75 grams protein, and 120 grams fat (1680 calories), and 20 units of insulin, polyuria was checked and the first 24-hour specimen of urine measured 1200 cubic centimeters and contained 4.8 grams sugar. But on November 29, the left knee became tender, red, and hot, the temperature rose to 100.4 degrees, and the 24-hour output of urine for the second day rose to 2350 cubic centimeters with 25.8 grams sugar. The diet was reduced to 60 grams carbohydrate, 60 grams protein, and 100 grams fat, and the insulin raised to 30 units. The amount of sugar excreted was 21.6 grams, and there were heavy nitroprusside and ferric chloride reactions. The abscess was incised and drained by Dr. A. S. Morrow on December 1, under novocain, the temperature became normal, and the glycosuria and acetonuria receded. After several days of freedom from glycosuria, during which time the blood sugar was found to be 0.11 per cent, there was a flareup on December 10, with elevation in temperature, and 6.8 grams sugar appeared in the urine. On a diet of 60 grams each of carbohydrate and protein, and 75 grams fat, and 20 units of insulin daily, the wound healed rapidly, and the patient was discharged on December 18 weighing 246½ pounds. With subsequent loss in weight, the insulin was discontinued, and in May, 1924, the patient weighed 220 pounds, was taking a diet of 125 grams carbohydrate, 100 grams protein, and 50 grams fat, and "had not felt better for 10 years." Incidentally, the skin of both legs had become firm and smooth, though deeply pigmented.

CASE 2. Diabetic gangrene, with sepsis and cachexia. Amputation of thigh. Uneventful healing of wound and return of tolerance under diet and insulin.

The course of E. C., a Scotchwoman, age 66, admitted to the Polyclinic Hospital on August 25, 1923, has been reported in detail (5). Immediately after operation on September 7, a diet with a relatively high carbohydrate ratio, 60 grams carbohydrate, 50 grams protein, and 60 grams fat, was given, with insulin in 20 unit doses. After 120 units, glycosuria and acetonuria disappeared. When fat was added to bring the diet to 1250 calories, the blood sugar remained high on 45 units of insulin per day. Therefore, while maintaining this caloric intake and the same amount of protein in the ration, carbohydrate was lowered and fat was raised. This diet, carbohydrate 30 grams, protein 50 grams, and fat 103 grams, so effectively spared insulin that a daily dosage of 25 units sufficed to keep the blood sugar at 0.12 per cent and promote healing of the wound. Under this régime, insular function returned to a considerable degree, so that this woman was discharged on a diet of 60 grams carbohydrate, 50 grams protein, 150 grams fat, without insulin. She went to a home for aged women, where, fortunately for her, the diet was plain and not too abundant, and she has remained in excellent health.

CASE 3. Mild diabetes of 30 years' duration. Prostatectomy. Uneventful convalescence under diet and insulin.

This man, age 72, German, manufacturer, the patient of Dr. A. R. Stevens, was admitted on July 12, 1924, after 5 days of marked symptoms from prostatic obstruction. Sugar had been discovered in the urine in the course of a sojourn at Carlsbad 30 years previously, and had always cleared up promptly on restriction of diet. The patient's mother and one brother died in diabetic coma, at 71 and 50 years respectively. Physical examination showed an elderly man in fair nutrition, weight 135 pounds, height 5 feet 6 inches. The urine on admission contained 1.2 per cent sugar, with a heavy trace of albumin, hyaline casts, many red and white blood cells. The blood sugar was 0.33 per cent but there was no nitrogen retention (non-protein nitrogen 28 milligrams, urea nitrogen 18 milligrams, creatinine 1.3 milligrams, uric acid 2.5 milligrams) and the phenolsulphonephthalein output was 90 per cent in 2 hours. On a diet of 60 grams carbohydrate, 60 grams protein, 50 grams fat, and 10 units of insulin daily, glycosuria disappeared at once, and the blood sugar was reduced to 0.22 per cent. The prostate was removed on July 18, with gas-oxygen anæsthesia. The postoperative blood sugar was 0.23 per cent, and carbon dioxide combining power 51 volumes per cent. The course was uneventful though somewhat slow. The patient's capricious appetite made necessary various changes in the diet and required the cautious use of the insulin. Thus one morning, after the insulin injection, he refused breakfast, and when trembling and weakness announced the onset of a reaction, he declined orange juice. Glucose by stomach tube terminated the attack. In general, the blood sugar approximated the upper level of normal, the patient regained weight and strength, and there were no setbacks in wound healing.

CASE 4. Adenoma of prostate, with multiple vesical calculi. Diabetes mellitus. Suprapubic cystotomy. Carcinoma of head of pancreas. Death.

J. G., male, age 75 years, Jewish, the patient of Dr. J. J. Valentine, had suffered from painful and frequent urination for a year. On admission on September 20, 1924, there was found 0.3 per cent sugar in the urine, 3.07 grams, and blood sugar 0.28 per cent. Urea nitrogen was 17 milligrams and creatinine 1.1 milligrams. The phthalein output was 40 per cent. Physical examination showed an undernourished and weakened old man, but the survey of the organs was essentially negative. With a diet of 60 grams carbohydrate, 50 grams protein and 30 grams fat, and 30 units of insulin daily in 3 doses, the blood sugar fell to 0.18 per cent on September 28, and the bladder was opened in the first stage of prostatectomy. The duration of the gas-oxygen anæsthesia was 30 minutes. The carbon dioxide combining power of the plasma fell from 63 volumes per cent preceding operation to 44 volumes per cent on following morning. On the diet, insulin kept the blood sugar at 0.18 per cent and below.

The third day after operation, slight icterus was noted, and as it increased, an enlarging mass in the right upper quadrant became more and more evident. The stools became gray and later slimy, and the urine was laden with bile pigments. Pruritus was marked for the 2 or 3 days preceding death, by which time there had developed a smooth round tumor, the size of an orange, in the region of the gall bladder. The necropsy following death on October 15 disclosed a carcinoma of the head of the pancreas, with marked dilatation of the common duct and gall bladder. There was marked fibrous replacement throughout the body of the pancreas, and the islands were diminished in number.

CASE 5. Diabetes of several years standing. Ruptured appendix, peritonitis and ileus. Death.

The history of this patient, a Jewish merchant of 53 years, illustrates the difficulties of using insulin when a severe infection is present and almost no regulation of the food intake is possible. He was admitted on February 2, 1924, with the history of acute epigastric pain for 2 days, associated with vomiting, but no abdominal tenderness until 4 hours before operation. This was performed by Dr. E. L. Kellogg, and disclosed a ruptured gangrenous appendix. The patient was an overweight, rather flabby individual and sugar was present in the urine on admission. He died on February 11 after a stormy course because of general peritonitis and paralytic ileus, with a terminal cardiac collapse.

The patient was able to retain very little nutriment by stomach or rectum, and while fluid intake was kept high by hypodermoclyses, food intake was irregular and scanty. Therefore insulin was given cautiously in doses from 5 to 20 units per day governed by the laboratory findings. On February 4, there was no glycosuria or diacetic acid, and the blood sugar was 0.29 per cent. Three days later, the blood sugar was 0.21 per cent and it was the same on February 8. There were strong acetone and diacetic acid reactions in the urine, but no glycosuria on February 8. The carbon dioxide combining power of the plasma was 41.4 volumes per cent. On February 9, there were 7.7 grams sugar in the urine, and strong ketone reactions, but on the 10th the reactions were definitely less. The temperature was 104 degrees on this day, pulse 116, respirations 45, and the patient succumbed during the night.

CASE 6. Diabetes mellitus. Carbuncle of neck.

This case is cited briefly to emphasize the freedom from complications when such conditions are treated early and vigorously. This man, aged 54, Irish, a mechanic, had had a boil on his neck for a month, with gradual enlargement and involvement of surrounding tissues. The carbuncle was incised in the surgical dispensary and the patient sent in to the ward. His urine contained 1.1 per cent sugar on admission, February 22, 1924. A diet of 50 grams carbohydrate, 65 grams protein, and 110 grams of fat was prescribed, the weight being 144 pounds, height 5 feet 7 inches. Insulin was started at the rate of 10 units a day. The blood sugar on the morning after admission was 0.21 per cent, carbon dioxide combining power 59 volumes per cent. The urine was sugar free throughout his hospital stay. The blood sugar was 0.13 on February 26, and the same on March 1, when the patient was discharged.

CASE 7. Obesity, diabetes, gangrene of foot. Amputation. Healing under large doses of insulin and restricted diet.

A. Z., female, age 55, German, a cook, was admitted on August 11, 1924, with infected gangrene of the left foot, which had started as a blister one week previously. She had not lost weight, nor had diabetic symptoms, and did not know that she had sugar in the urine until admission. Examination showed an obese woman, weighing about 160 pounds, of short stature (about 5 feet 1 inch) lying in bed, with a gangrenous area on the back of the foot, an area of acute inflammation above, and tenderness extending into the middle of the leg. Acceding to the patient's wishes, operation was postponed, but a diet restricted to 60 grams carbohydrate, 50 grams protein, 30 grams fat, calories 810, and 75 units of insulin a day did not suffice to clear up glycosuria. A thigh amputation was carried out by Dr. Thompson on August 28, but, surprisingly enough, though the patient ran an afebrile course, and the wound remained clean, large doses of insulin continued to be necessary. After operation, the blood sugar went up to 0.44 per cent, and though the diet was reduced, the blood sugar remained at a high level with 75 units daily. Insulin effect was studied during a fast day on September 10. The early morning blood sugar was 0.37 per cent. At 12 o'clock, after the first dose of insulin given at 9 a.m., the blood sugar

TABLE I.—PATIENT A. Z.

Date 1924	Diet C gm.	Diet p gm.	Diet F gm.	Urine Sugar	Urine Diac.	Blood Sugar Per cent	Insulin units per day
Aug. 12	36	38	135	1%	+	0.37	15
14				1.2%	++	0.28	15
15				1.5%	++++	0.31	25
16	60	50	30	1.0%	+		30
18				1.0%	0	0.37	45*
22				11 gm.	0		60
23				6.25 gm.	0		60
24				4.5 gm.	0		60
28				0.5%	0	0.27	60†
29				1.0%	0	0.44	75
Sept. 3	36	50	50	0.9%	0	0.29	75
6				0.5%	0	0.27	75
10				0.6%	0	0.37	75
11	30	50	30	0	0	0.25	90
12						0.25	90
13				0	0		120
16				0	0	0.19	120
19				0	0	0.15	120
23				0	0	0.16	120
29				0	0	0.20	120
Oct. 6				0	0	0.26	120‡
8				0	0	0.22	120

*Infection advancing.

†Amputation CO_2 60 Vols. per cent.

‡Breaking diet?

was 0.24 per cent; and at 3 p.m., after the noon dose of 25 units, the blood sugar was 0.22. Thus 50 units of insulin in this patient had reduced blood sugar by 150 milligrams. By further reducing the diet, as shown in the chart (Table 1), and raising the dosage of insulin to 120 units per day (1 cubic centimeter U-40, 20 to 30 minutes before meals) the blood sugar was finally brought down to a normal level. One probable insulin reaction, characterized by a fall in temperature, weakness and nervousness, and without tremor, sweating or vomiting, occurred one evening, 2½ hours after the insulin injection. This was relieved by a hot saline clysis and adrenalin and the next morning the blood sugar was 0.26 per cent. The wound healed by primary intention and was entirely closed on October 12.

CASE 8. Diabetes of 5 years duration, gangrene of foot, influence of insulin on healing.

L. K., female, 53, French, was admitted on March 19, 1924, with gangrene of the right foot, which had started as a corn 8 weeks before. Her weight was 220 pounds at the age of 35, 185 before the present illness, 146 on admission. Sugar was found in the urine 5 years previously. Pallor was so marked as to suggest chronic nephritis. Amputation was done by Dr. F. H. Russell on April 4, 1924, and 21 days later the stump was healed and dry. The patient was carried along on a diet of 60 grams carbohydrate, 50 grams protein, 60 grams fat, with 30 units of insulin per day, the urine being free from sugar and the blood sugar varying from 0.20 per cent to 0.23 per cent. At this latter figure, it was noted, on May 1, that the suture line was cyanotic, with a serosanguinous secretion and one small necrotic area the size of a dime, and that the skin edges seemed to show beginning necrosis. Therefore the insulin was raised from 30 to 45 units per day, while the carbohydrate portion of the diet was lowered to 50 grams. The result was that on May 3 the blood sugar was 0.14 and the retrogressive process in the wound had been entirely checked. The patient left with her blood sugar at this same level 2 weeks later, and in a most satisfactory general condition, her pallor supplanted by excellent color of skin and mucous membranes.

The subsequent history of this patient, whom I did not see again, has since come to my attention. She was not kept sugar free by her physician, and gangrene of the other leg supervened. Finally amputation was carried out, and the patient died in coma 24 hours later. Although the operation was done by a competent surgeon, it was surprising to learn that no laboratory examinations were made either before or after the operation.

The lesson is that the closest supervision and painstaking attention to details are absolutely necessary when diabetics undergo operations.

SUMMARY AND CONCLUSIONS

By the use of properly balanced and restricted diets and adequate doses of insulin, carbohydrate combustion sufficient to prevent acidosis may be maintained. Similarly, the level of the blood sugar may be kept low, thus providing an essential basis of satisfactory wound healing. In general infections should be given the benefit of early operation, from the standpoint of the diabetes as much as from that of the surgical condition.

The welfare of the diabetic patient requiring surgical operation, demands respect for the principles of metabolism in diabetes and the methods of their application.

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TORSION OF THE GREAT OMENTUM

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A LARGE number of cases of torsion of the omentum have been recorded since Marchetti in 1851 first reported one (Mauclaire, 30), and Oberst (36) again drew attention to the subject in 1882. However, it is rarely considered as a possibility by the great majority of surgeons, when making a differential diagnosis of an acute abdominal condition. Reidel (43) quoted by Fuller (17), says: "Given an instance in which the normal omentum is free from pathology of whatever kind, torsion or rotation would probably never occur," and it is remarkable that, although omental adhesions are very common, torsion of the structure is very uncommon (Muller, 35). However, the anatomy and physiology of the omentum is such that it would seem to be particularly prone to twists and it is almost certain that the normal omentum does undergo such movements frequently, but just as readily returns to normal, after causing many of the vague, indefinite, abdominal pains which often defy diagnosis. While no effort has been made to review the literature completely or to compile an exhaustive bibliography, it is interesting to note Corner and Pinches' (11) statement that by 1904 there were 53 cases on record and Block and Darmstadter's (5) remark that Bookman had collected 131 cases up to 1915. Fuller (17) goes into the embryology of the omentum and states that it is fully developed in man in the second year after birth. He remarks that we are indebted to Meckel for the earliest information concerning the organ. It passes into the pelvis in 25 per cent of male and 50 per cent of female subjects. Lockwood, quoted by Fuller, observed that in 50 per cent of cases examined under 45 years of age the omentum could be brought down to the symphysis pubis and in persons over 45 years it was the rule, when pulled down, for it to pass well below the limits of the abdomen. The tendency of the great omentum to alter the currents within the peritoneal cavity led Tait to designate it "the arbiter of peritoneal tides," and its function in checking peritoneal inflammatory conditions led Robinson to name it the "policeman of the belly." An accessory omentum may be the site of volvulus as in a case reported by Cullen (12).

The functions of omentum are:

1. Circumscribing and limiting infection within the abdominal cavity.
2. Protection by wrapping around damaged areas.
3. Protection by plugging openings in hollow viscera or the abdominal wall.

It possesses a wide range of motion, normally floating free in the abdominal cavity and the experiments of E. de Renzi and Boeri (44) show how, in a few hours, the encapsulation of other structures takes place when deprived of their blood supply.

PATHOGENESIS

Torsion in cases wherein the omentum has in its distal end a mass which is free or has become free through twisting. Nearly every case of reported torsion of the omentum was associated with some form of inflammation, either within or without the abdomen as in a hernia (Luckett, 29). Shoenholzer quoted by Thevenard (54) says categorically: "No inflammation, no torsion." That hernia plays an important rôle in the causation of omental torsion is evident from the large percentage of reported cases in which there has been an associated hernia. It is usually the right inguinal variety which has been of long standing and usually reducible. Vignard and Girandeau (56) reported 20 cases of torsion, inguinal hernia being present 19 times. There was no instance of femoral hernia. In Stewart's (52) group, hernia was present in all but five of 33 collected cases. Corner and Pinches (11) report 47 herniæ present in 53 cases. In none of them has a femoral hernia been present. One of the dangers of taxis in strangulated hernia is omental torsion (Watson, 58). The presence of a hernial sac into which the omentum, over a course of time makes its entrance and exit,

with constant irritation, results in a thickening and inflammation of the omentum at its lower end, forming a mass like the bob on the end of a plumb line. Jabouley, quoted by Aimes (1), explains the torsion as follows: as the omentum is in constant motion, it has a tendency to roll, and after the first twist, the resulting congestion increases the volume of the mass causing a new rotation. Cathelin (7) calls the process a vicious circle, in that the larger the mass becomes the more it is apt to twist, and the more it twists the larger it becomes. In addition to the enlargement of the tip of the omentum due to irritation in a hernial sac, the volvulus may be enhanced by a number of other pathological processes, resulting in the formation of a mass. Conditions which might readily lead to torsion are sarcoma (Downs, 13), lipoma (Meredith, 32), cysts (Waldy, 57), (Wells, 59), (Segond, 48), colloid disease (Bowen, 6), endothelioma (McFarland, 31), (Morton, 34), and hydatid cysts (Considine, 9), (Owen, 37).

Torsion in cases in which the distal end of omentum is adherent in hernial sac or about inflammatory area. In this type of torsion the tip of the omentum, being adherent in the pelvis, because of the presence of an inflammatory process such as a suppurating tube or pelvic appendix or hernial sac, the organ becomes a sort of sling and rotates as one might twist a handkerchief by grasping it at opposite corners and then twirling it. The twists in this case, which are usually two, begin at each end and progress toward the middle, whereas, in the first type the solitary twist ordinarily begins at the lower extremity and progresses upward. The theory of Bazy (4) who, after a study of the physiology of the omentum, contends that its movements are transmitted to it by the movements of the intestine, is perhaps most reasonable in such cases and exemplified by a case recorded by Morestin (33) in which the torsion followed purgation.

Cases in which the apparently free omentum twists without being the site of a mass or being adherent in the pelvis. In the purely intra-abdominal variety of torsion, of which Rudolf (46) collected 23 instances, the explanation given by Payr (39) seems logical. After a very ingenious series of experiments, he concluded that because the veins are larger and more tortuous than the arteries, when the veins are compressed by a kink of some kind, they become turgid and full of blood. The arteries form a tense cord about which the omentum turns and, once started, the twisting continues with resulting obstruction to the circulation and subsequent gangrene. The essential change in the omentum itself is inflammatory and is characterized by thickening and adhesions. Continuation of the process leads to vascular obstruction, hæmorrhage and death of the organ. In certain instances the omentum has time to graft itself on a viscus or the parietal peritoneum and so obtain a blood supply from below. This probably explains the finding of a mass, seemingly free from the rest of the omentum, to which it is adherent by a fibrous cord. The hypertrophy of the omentum may be great. Hockenegg (21) resected a portion as large as an adult head, Baracz (2) one weighing one kilo, Lucas-Championniere (28) 645 grams, Hawkes (20) removed a mass the size of two fists, and Woolsey (61) removed an omental mass as large as a grape fruit. Hotchkiss (22) in discussing Erdmann's (14) paper, related an instance in which the portion removed weighed 5 pounds. On the other hand atrophy may occur to such a degree that the omentum appears as a thin, rolled up cord crossing the intestinal coils (Tremolieres, 55).

When the process is slow and gangrene does not immediately develop, the torsion may be so complete that the omental tumor becomes completely detached, as occurred in a case seen by Grant (19).

CLASSIFICATION

That of Aimes (1) is comprehensive and is as follows:

I. Partial torsion
   a. Intra-abdominal
   b. Intrasaccular
      1. In an empty sac
      2. In an occupied sac.

II. Total torsion
   a. Abdominal or omental volvulus
   b. En masse (intra-abdominal and intrasaccular).

III. Complex torsion
  a. Associated with tumors of omentum
    1. Cysts
    2. Sarcoma.
  b. Associated with other lesions
    1. Appendicitis
    2. Cysts of ovary
  c. Torsion of inflammatory tumors
    Reduction en masse.

Payr, quoted by Wilensky (60), makes a simpler classification.

I. Torsion without co-existing hernia
  a. Of omentum only
  b. Of omentum and adherent viscera.

II. Torsion with co-existing hernia
  a. Of intra-abdominal portion only
  b. Of hernial portion only
  c. Complicated cases
    1. Involving both portions
    2. Either type associated with retrograde incarceration.

Torsion of the omentum may also be classified as acute or chronic, primary or secondary.

Among the immediate causes are: direct trauma of abdominal wall, Cernezzi (8); coughing, Bayer (3); efforts at lifting, Forgu-Lapeyre (16); bicycle racing, Thevenard (54); dancing, Pretsch (41); hard labor, Reidel (43); taxis of hernia, Lejars (27); violent purgation, Morestin (33).

SYMPTOMS

Swain (53), in commenting upon the long list of possible causes of acute abdominal trouble, states that in every case the first symptoms are about the same, whatever the cause may be, not being instituted by the distinctive characteristics of the lesion, but by the effects of the lesion upon the peritoneum, manifesting themselves by pain, vomiting, more or less collapse and interference with the onward passage of the contents of the intestinal tract. Lefebre (26) also mentions the effect of torsion of the viscera upon the abdominal sympathetic and its manifestations of a secretory order, vasomotor, heat regulatory, respiratory and circulatory order, accounting for the symptom complex in such cases. Price (42) states that acute torsion of the great omentum occurs with sufficient frequency to be considered as a possibility in a typical acute abdomen, especially in male patients with a pre-existing hernia and a low polynuclear count.

The patient is usually a male of middle age, who has had an inguinal hernia for some years. As a rule the hernia has been reducible but more or less troublesome, and often becomes irreducible just before the onset of torsion. The beginning is often acute but may be developed by a series of steps or crises more or less apart, being due to some of the slow increments of torsion forming the twists (Corner and Pinches, 11). Pain, which is rarely agonizing, is the prominent and the only constant feature. It is usually located in the region of the hernia and radiates upward. Often it is increased by movement and relieved by rest. There is more or less tenderness, and as a rule, slight abdominal distention. Careful investigation may reveal the presence of slight movable dulness in the flanks as the condition progresses. Nausea is nearly always prominent. Vomiting may or may not occur but is rarely severe or continued. Corner and Pinches (11) state that it is present in only 35 per cent of the cases. There may be complaint of a moving or twisting sensation (Smythe, 51). The bowels are usually open, gas and fæces being passed, and diarrhœa may occur. The temperature is slightly elevated and the pulse, as a rule, accelerated. Often a mass or indurated area can be felt in the right iliac region. It may be elongated and movable laterally, and is usually tender. Mauclaire (30) noted that the whole region from the iliac fossa to the scrotum became prominent. Gillette (18) thinks that many obscure abdominal pains are due to omental torsion.

DIAGNOSIS

The diagnosis has been made before operation in a number of cases (Lejars, 27, Morestin, 33, and Payr, 39). If the possibility of torsion is considered, the diagnosis should not occasion great difficulty in a typical case. It is most commonly confused with acute appendicitis with abscess. The following points should enable one to differentiate the condition.

Torsion of the Omentum	*Appendicitis*
A history of crises of cramp-like pain and indigestion over some years.	As a rule no history of recurring attacks, or at least not more than a few.
Age. Largest number in fifth decade.	Earlier, between 15 and 45.
Sex. Nearly all males.	Incidence more equally divided.
Hernia of the inguinal type present in a large proportion of the cases, usually of long standing; or an empty hernial sac.	Hernia—no relationship.
Pain usually below the umbilicus instead of around it and later the pain is most severe in the mid-abdomen and hernia, instead of about McBurney's point.	Pain usually about the umbilicus, and later localized about McBurney's point.
Vomiting frequently precedes the pain and is rarely marked.	Vomiting most often follows the pain.
Tenderness and rigidity as a rule not marked, usually more general.	Tenderness and rigidity usually prominent and more localized in the right iliac fossa.
Tumor present early, and may be movable from side to side. It is more elongated and situated more toward the mid-line and does not extend to the lateral border of the pelvis. There is usually an area of resonance to its outer side.	Tumor appears after 2 or 3 days, rarely movable.
Leucocytes as a rule not greatly increased.	Leucocytes usually increased to 15,000 to 20,000.

PROGNOSIS

When submitted to early operation, recovery is the rule. Corner and Pinches (11) record a mortality of 13.2 per cent in 53 cases, and Muller (35) states that the death rate is 14 per cent. However, these statistics were taken from cases seen when the condition was first being recognized and Corner says: "There are few conditions which show so small a mortality in the first chapter of their history." At present the mortality should be practically nil. Gillette (18) performed an autopsy upon a man whose death had been caused by gastric and colonic hæmorrhage, both stomach and bowel being filled to distention with blood. Embolism was the cause of death in a case recorded by Perier (40). In others the fatal result has been due to infection of the gangrenous mass of omentum, peritonitis or obstruction of the intestine. The presence of hæmorrhage subsequent to torsion, or of hæmorrhagic areas, constitutes a danger, they being easily infected when in proximity to suppurative foci or adherent intestine. The torsion may so shorten an adherent omentum that the colon becomes kinked by being pulled down into the pelvis. Patel (38) mentions an instance in which the transverse colon was drawn into the internal inguinal ring, and Kraske (23) had a patient in whom obstruction of the transverse colon was due to a torsion of the omentum following failure to rearrange it after the Trendelenburg position has been used. When the condition is allowed to go on to its natural conclusion, death occurs. There are instances, however, of partial torsion in which there occurs a succession of crises leading to digestive trouble and abdominal pain lasting over years.

TREATMENT

The treatment is, of course, always operative and an incision large enough to explore the entire omentum should be made. The possibility of an accessory omentum being present should be kept in mind. Simple untwisting will not do, as has been remarked by Skeel (49), Ritter (45), myself and others. It is necessary to resect all of the twisted portion, sparing as much of the omentum as can possibly be allowed to remain. It is necessary, however, to be sure that in removing one twisted portion, another one higher up is not overlooked, as in a case of Eiselsberg and De Moresco (15), quoted by Mauclaire (30). The tissue should be handled gently and the possibility of embolism kept in mind when high resections of the organ are done. The omentum should not be ligated in thick, clumsy masses, but in sections which can be included in a reasonable mass, and the cut ends should be covered or so turned in that they do not present raw stumps to become adherent. Resection should not complete the operation, but a search must be made for the associated pathology, as torsion rarely occurs alone but in company with inflammatory

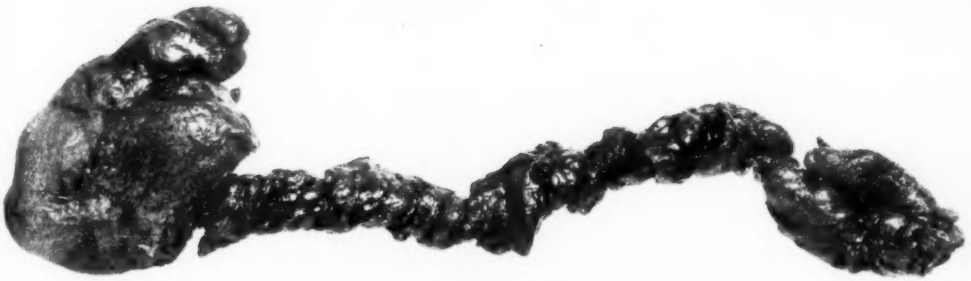

Fig. 1. Case 1. Entire omentum twisted into cord.

processes—cysts, tumors, and hernia, which should be treated as indicated. In the operative treatment of herniæ, one of the advantages of repairing the hernia from within, as advised by La Roque (24, 25), is the elimination of possible torsion due to an adhesion made by including a tip of omentum in the ligature of the sac at its neck, as can be done so easily when the sac is ligated from below. In certain herniæ in which the sac is found to be inflamed, it is advisable to investigate the condition of the omentum in the abdomen. Smith (50) reports finding inflammatory changes in 37 out of 250 inguinal hernia sacs removed at operation. Torsion should be looked for carefully in all epiploceles of long standing, particularly if there has been a history of recurring attacks of abdominal pain and more or less digestive disturbance over several years. It is possible to overlook a twist in the omentum unless it is made a point in the exploration of the abdomen. "A clinical feature which is useful in directing the surgeon's attention to the possibility of torsion when operating upon an omental hernia with symptoms of strangulation, is this: if the neck of the omentum is easily moved within the inguinal canal, which is consequently loose and not strangulating the omentum, the symptoms are caused by something else and torsion of the contents of the sac should be looked for" (Corner and Grant, 10). At the conclusion of all abdominal operations in which the Trendelenburg position has been used, it is, of course, imperative to unfold and to rearrange the omentum carefully by spreading it out in its normal position over the bowel. A rolled up omentum is more apt to become twisted than one which is normally placed. Upon opening the peritoneum the escape of a dark, bloody fluid has been very frequently noted. This should always suggest to the operator, first, the possibility of free intra-abdominal hæmorrhage and, second, the oozing of blood from some twisted viscus or omentum.

SUMMARY

1. Torsion of the omentum occurs with sufficient frequency to be considered as a cause of obscure abdominal pain.

2. Exploration of the abdomen should always include an investigation of the entire omentum.

3. In the treatment of herniæ, care should be taken not to include the tip of the omentum in the ligature on the neck of the sac, and whenever it is necessary to resect a part of the omentum, all raw stumps should be small and turned in or covered, so as not to become adherent.

CASE 1. One day in the summer of 1915 there came into the Receiving Ward of the Pennsylvania Hospital, a man of 34, who had, for 3 days, complained of sickening pain in his abdomen. This was accompanied by almost constant nausea and occasional vomiting. His illness had begun with abdominal discomfort while he was at work and became more severe as the days passed. Nausea had been present from the onset, but he did not vomit until the evening of the first day. He was unable to work the following day and in addition to pain, he had a sensation of something moving in the right side of the abdomen and he "felt a lump" there. The symptoms became more severe, so that 3 days after

the onset he sought admission to the hospital. His bowels had moved normally daily. Temperature, 100.3 degrees; pulse, 104; white blood cells, 9,000. With the exception of the abdomen, the physical examination was negative. There was slight abdominal distention and slight rigidity and tenderness on the right, more pronounced below the level of the umbilicus. No hernia. No demonstrable free fluid and the solid viscera were apparently normal in size and outline. A mass, roughly spherical and seemingly about 2 inches in diameter, was palpated above Poupart's ligament on the right. It was slightly movable and quite tender, and when forcibly moved, caused a wave of nausea. Rectal examination was negative. The diagnosis of acute appendicitis, with abscess, was made and operation done at once.

When the peritoneal cavity was opened a small amount of dark bloody serum escaped. The appendix was seen at once and was not the cause of the trouble. The mass was felt at the upper extremity of the wound and was delivered, proving to be an œdematous, purplish, twisted omentum, with a ball-like mass forming the lump complained of by the patient. The omentum was ligated at its upper extremity and the diseased portion removed (Fig. 1). The wound was closed without drainage and he made an uninterrupted recovery.

Since seeing this patient I have operated upon two others presenting similar symptoms due to torsion of the omentum, but each showing some unusual feature.

CASE 2. A man, carpenter by occupation, 31 years old, complained of pain and tenderness in the right iliac fossa. For 10 years he had had an indirect inguinal hernia on the right side. It frequently came down but had always been easily reduced. Four days before admission he, for the first time, had some difficulty in reducing the hernial mass which was painful and swollen and had been down for 2 hours before he got it back. It did not come down again but he continued to have pain and tenderness in the right abdomen, low down. No vomiting. Bowels were regular.

Physical examination showed a thin, muscular adult male. Temperature, 101; pulse, 96; white blood cells, 14,000. The abdomen was slightly distended and tympanitic except over a definitely palpable, elongated mass which was felt in the right iliac region, extending upward from Poupart's ligament. It was smooth, rounded, elongated and tender. There was slight tenderness and some rigidity over the right lower quadrant. The right inguinal canal was not occupied by the hernial mass but the external ring was enlarged and tenderness was marked when two fingers were inserted through the ring.

Diagnosis of inguinal hernia with an inflamed appendix in sac was made.

Operation. Kammerer incision. When peritoneum was opened a small amount of odorless bloody fluid escaped. A purplish, brawny mass was seen just beneath the wound. It proved to be the omentum, which was adherent at its lower extremity to the internal ring and was twisted into a spiral rope-like mass up to its upper attachment. It was ligated and removed. The appendix, which was acutely inflamed, but in normal position, and not in the sac of the hernia, was removed and the wound closed without drainage. The hernia was repaired as his condition was good. Recovery uneventful.

CASE 3. A female, 31 years of age, complained of pain in the lower right abdomen. Periodic appearance of a lump in the lower end of the scar of an old operative wound. Six years before admission she had been operated upon elsewhere for chronic appendicitis and 4 years later for a malposition of the uterus, also elsewhere. For a few months after the second operation she felt very well; then she began to have pain at the time of her periods when a small lump would appear in the lower end of the old scar. The pain was sharp, referred to her back at the level of the twelfth rib and was sickening in character, being accompanied by nausea and frequent vomiting. This was always worse at the time of her periods. After several days the lump would disappear, the pain subside, and a chocolate-colored vaginal discharge appear. The disability had been growing more severe with each attack.

Physical examination showed a pale, undernourished, young, white woman. Examination of the abdomen shows 4-inch cicatrix through the lower part of the right rectus, at the lower angle of which there is a firm, tense, extremely tender, rounded, reducible swelling the size of a walnut. Pressure upon it increases the nausea. The liver and spleen are normal in size and outline. No femoral or inguinal hernia can be demonstrated. Peristalsis is normal; no free fluid. The diagnosis of incisional hernia was made, and it was thought that the ovary was involved in the hernia, thus explaining the periodicity of the attacks.

Operation (*ether anæsthesia*). In opening the abdomen a pocket of thick, chocolate-colored fluid in the wall was entered. This proved to be the dilated right fallopian tube. Apparently the tube on each side had been grasped at its middle and pulled through the rectus muscle and fixed to the outer sheath, in order to suspend the uterus. A section of the round ligament had been removed on each side, a permanent witness to the intention and lack of anatomical knowledge of the operator. The pain was due to herniation of the tube with distention. The omentum, which was adherent to the inner aspect of the herniated tube, had been rotated several times as one would twist a handerchief by holding it at two opposite corners and twirling it. The twist could not be undone, so the omentum was ligated and removed. A hysterectomy was then performed and the wound was closed without drainage. Recovery uneventful.

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SUPERFETATION—A PROBABLE CASE[1]

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MOODIE[2] defines superfetation as the presence of two fetuses of different ages due to the fertilization of ova liberated at different ovulation periods. This differentiates it from superfecundation which is the fertilization of two or more ova liberated at the same ovulation period.

Since the possibility of the occurrence of superfetation has been a matter of controversy since the days of Hippocrates and is yet claimed by some to be an impossible event; and since we have found no reported case which we think fulfills all the requirements of proof necessary to remove it from the realms of controversy; in reporting this case we hesitate to do more than give the findings and leave to others the privilege of interpreting them.

In the literature of superfetation many cases are recorded in which the diagnosis is based upon a difference in the stage of development of the two fetuses, and in most of them either one of the fetuses is dead, usually the smaller one, or nothing is said in reference to this point. Even when both are alive a difference in development does not prove the case and when one is dead this difference can be still more misleading because it is probably true that postmortem degenerative changes are retarded by the concomitant conditions and the time of death can therefore be less accurately estimated.

The changes which take place in the corpus luteum of pregnancy during growth and regression do not differ materially from the changes which take place in the corpus luteum of menstruation except in the time at which they are manifest. These changes are shown in the arrangement of the lutein cells, their degeneration, and the ingrowth of connective tissue. They are essentially the same in both but in the corpus luteum of menstruation they begin at once and are complete in a few weeks while in the corpus luteum of pregnancy they begin in the second or third month and are often completed only during the puerperium. It is true that the rapidity with which these changes occur varies widely in different individuals, and while it is therefore impossible to determine accurately the length of the pregnancy by an examination of the corpus luteum a difference between the ages of two corpora can be determined when it exists.[3]

In most cases the pregnancies are intrauterine, the delivery spontaneous and the mother survives, and it is manifestly impossible to determine the condition of the corpora lutea with respect to a difference in their states of development or regression. When this can be done, however, it is the greatest factor in the determination of a difference in the ages of the fetuses. We have been able to find only one case in which the claim of superfetation was based upon a demonstrable difference in the structure of the corpora lutea found at autopsy.[4] This difference in structure was largely a difference in the amount of connective tissue present, and such is the condition manifest in the two corpora lutea found in the case which is reported in this article.

We, therefore, are of the opinion that to be beyond suspicion and closed to controversy a case should present two living fetuses of different ages and two corpora lutea in different stages of development corresponding as near as may be to the ages of the fetuses. Doubtless this is a requirement difficult to fulfill, and while necessary for absolute proof something less may prove the case beyond a reasonable doubt.

In reviewing the negative side of the question of the possibility of superfetation we find the following reasons given:

1. That the plug of mucus which exists in the cervical canal prevents ingress of spermatozoa.

2. That the uterine ostia of the tubes becomes closed in pregnancy.

[2] Moodie. Surg., Gynec. & Obst., 1915, xx, 561.

[3] Walthard. Ztschr. f. Geburtsh. u. Gynaek., 1923, lxxxvi.

[4] Wolff. Arch. f. Gynaek., 1900, ix, 291–296.

[1] Read at the meeting of the Southern Surgical Association, December, 1924.

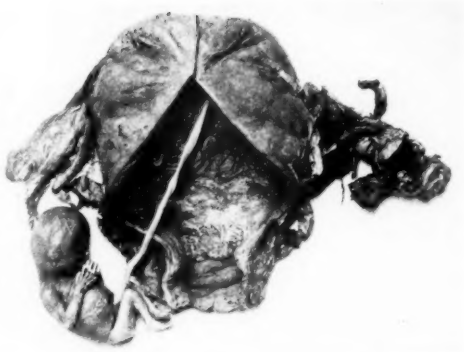

Fig. 1. Uterus removed postmortem. Shows the uterine fetus removed from the uterus and the ectopic fetus still in position in the left tube.

Fig. 2. Shows relative size and development of the intra- and extra-uterine fetuses drawn to the same scale.

3. That during pregnancy the corpus luteum inhibits ovulation and thus prevents the fertilization of a second ovum.

4. That it is impossible for the spermatozoa to traverse the already pregnant uterus.

5. That a decidual reaction having already taken place, a second is impossible in response to the second conception.

In the light of our present knowledge the first three reasons may be summarily dismissed. The plug of mucus is not always present, the uterine ends of the tubes have been found open in the third month of pregnancy [1], and the corpus luteum does not always prevent ovulation.[2]

The demonstration of an undoubted case of superfetation is the only way to prove positively that spermatozoa can traverse the uterine cavity in the presence of pregnancy. It may be stated, however, that the uterine

[1] Radish. Surg., Gynec. & Obst., 1921, April.
[2] Cosentino. Zentralbl. f. Gynaek., 1897.

Fig. 3. Low power photograph of the corpus luteum of the left ovary showing the closely arranged lutein cells. This also shows the small amount of connective tissue present.

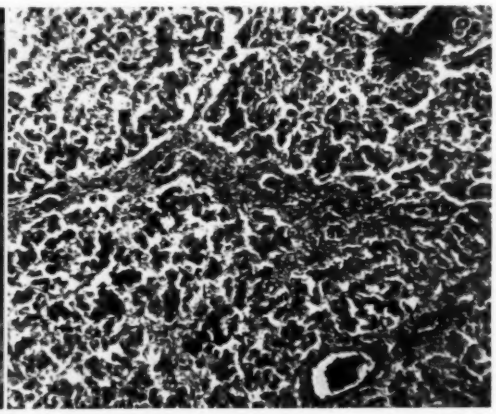

Fig. 4. Low power photograph of the corpus luteum of the right ovary showing the wide spacing of the cells and the greater amount of connective tissue present. Same magnification as Figure 3.

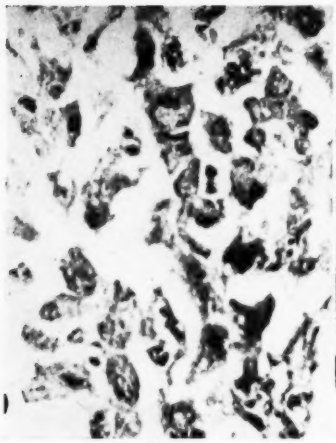

Fig. 5.

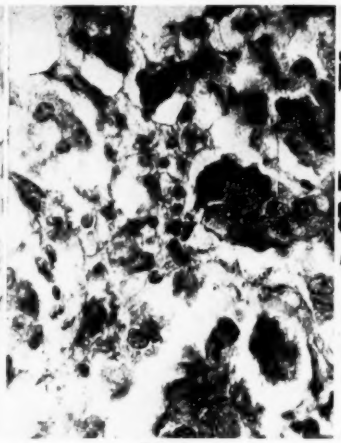

Fig. 6.

Fig. 7.

Fig. 5. High, dry magnification of cells of the corpus luteum in left ovary showing almost total absence of connective tissue.

Fig. 6. High, dry magnification of cells of the corpus luteum of right ovary showing the presence of much connective tissue.

Fig. 7. Section taken from the ectopic fetus (which was dead) to show the condition of the nuclei. Note that while there are some nuclei scattered around in a state of degeneration the majority are intact and stain well, indicating that death had not been so remote as to give rise to advanced degenerative changes.

cavity is not filled by the conceptus until after a lapse of several weeks and that the vera and reflexa do not become fused as was once thought.

Concerning a second decidual reaction, this may be true if the second ovum is intrauterine but does it apply when the second ovum is ectopic? In ovarian and in both primary and secondary abdominal pregnancies the placental development takes place in connection with structures far removed from the endometrium. Since the normal decidua is a connective tissue product one might ask if it is impossible for connective tissue elsewhere to answer the purpose.

This specimen, Figure 1, was removed postmortem from a colored woman 35 years of age who died in the wards of the Memphis General Hospital from pulmonary tuberculosis.

Her history gave no suspicion of a tubal pregnancy. There was no history of rupture, no blood in the abdominal cavity, and the tube was intact when removed. The specimen was sent to Prof. Simpkins of the Department of Embryology of the University of Tennessee, who reported as follows:

Upon examination the uterus proved to contain a well formed fetus and in addition had a smaller embryo in the left fallopian tube. The larger uterine embryo seemed normal in every respect and was so much larger than the tubal one that a study was at once made to determine if possible the cause of the discrepancy.

The larger of the two offspring was carefully examined and measured in its natural position within the uterus and found to be normal in every respect, Its crown-rump length was 90 millimeters without straightening or moving the head from its natural position; the crown-heel length was 147 millimeters. The length, 90 millimeters, is 9 millimeters more than the average length of an embryo at 13 weeks, and yet the variation in the length of a 13 weeks' embryo ranges from 78 to 132 millimeters according to the tables of Michaelis. The mean length of a 14 weeks' fetus is 100 millimeters, just 10 more than the length of the present specimen, the range of variation is also 78 to 132. The average crown-heel length is 117 millimeters at 13 weeks, 30 millimeters less than this one. The average for 14 weeks is 145 millimeters with a minimum of 113 millimeters and a maximum of 178 millimeters. The crown-rump length hardly indicates 13 weeks, but the crown-heel points to an excess of 14 weeks, hence I deem it safe to estimate the age of the fetus under consideration as 13 or 14 weeks. The measurements were made upon the preserved specimen and probably are a little low, as the specimen may have shrunken in the 10 per cent formalin. If there is any error in the estimation of the age it would be on the conservative side.

The tubal embryo measured 11 millimeters in its greater length, which according to the table of Felix indicates an age of 6 weeks. The length varies for

6-week embryos from 4 to 25 millimeters. The maximum and minimum for 7 weeks of gestation is 9 to 37, hence it seems as if the age of the smaller embryo falls somewhere between the sixth and seventh weeks.

In computing the age of the embryos from their size, a hiatus of 7 weeks separates the two. The tubal embryo was not living at the time of the maternal death. How long it had been dead can scarcely be estimated but some insight may be gained by comparing the cellular dissolution of the tubal offspring to the condition of the cells of the uterine fetus which showed no signs of necrosis. Microscopic examinations of sections of parts of the tubal embryo show that the cells are scattered and loosely connected by cytoplasmic strands; their nuclei are few, scattered, small, compact, and darkly staining, a condition that does not indicate a very long process of postmortem degeneration. After prolonged dissolution of dead cells the nuclei disappear completely. We may safely conclude that the death of the smaller organism is not entirely responsible for the difference in size of the two embryos.

The presence of corpora were not detected in either ovary by external inspection, but as soon as the ovary was cut open the yellow bodies were at once discernible. Only one corpus was found in each ovary and these differed enough in their macroscopic appearance to warrant a closer study under the microscope. In the gross the corpus luteum of the right ovary measured 11 by 12 by 3 millimeters. Its color was a pale pink and its texture homogeneous. Thin slices, about 1½ millimeters thick, were cut from this part of the ovary and sectioned 10 micra thick. These sections were stained with hæmatoxylin and eosin and examined. Lipoid granules were seen in the granulosa cells and abundant connective tissue septa ramified throughout the body. The central part of the corpus luteum stained lightly and was composed entirely of connective tissue fibers and cells, with a profuse infiltration of blood cells. The process of vascularization was complete and copious. Very little pigment of keratin, lutein, or lipochrome could be detected. Colloid material was not identified.

The left ovary, the tube of which contained the ectopic embryo, held a smaller corpus luteum 9 by 7 by 3 millimeters. The central core was small and not so infiltrated with connective tissue cells or fibers as the one in the right ovary, and in contrast to it appeared to be solid. Very few lipoid granules could be found. The connective tissue septa were feeble and less extensive. No colloids were found and no pigment was noticeable. All the foregoing features are characteristic of young corpora lutea of pregnancy.

Hence, it is my conviction that the corpus of the left ovary is much less than 2 months old and has developed from the follicle that ruptured to contribute the ovum for the tubal gestation, and that the corpus of the right ovary is more than 2 months old and is the result of the ovulation that started the uterine pregnancy. Supporting this contention is the presence of a 6 or 7 weeks' embryo in the tube and a 13 or 14 weeks' one in the uterus.

The corpus of the right ovary is older and is in a state of maturity, and at the same time it is properly functioning without showing marked signs of retrogression.

The corpus of the left ovary is younger, and is still in the ascending phase of its growth.

SUMMARY

In the case reported there were two fetuses, one intra-uterine, one extra-uterine, showing a difference in development.

There were two corpora lutea, one in each ovary, showing marked difference in development, the difference being in the arrangement of the cells and the amount of connective tissue present.

Though the ectopic fetus was dead and there were some signs of degeneration present, these changes were not enough to give the impression that the fetus had been dead any length of time.

Though not fulfilling all the requirements necessary for absolute proof, still this case apparently proves superfetation beyond a reasonable doubt.

THE CLINICAL USE OF SODIUM TETRAIODOPHENOLPHTHALEIN IN CHOLECYSTOGRAPHY[1]

By GIBBS MILLIKEN, M.D., and LESTER R. WHITAKER, M.D., Boston, Massachusetts

THE intravenous injection of opaque media for roentgenographic visualization of the gall bladder was first reported by Graham and Cole (4). The method is an adaptation of the phenoltetrachlorphthalein liver function test introduced in 1909 by Abel, Rowntree, and others (1).

Graham and Cole first employed tetraiodophenolphthalein but believed it to be too toxic for clinical use. Calcium tetrabromphenolphthalein was then tried, but found to be too insoluble for convenience, and they have since come to recommend the use of sodium tetrabromphenolphthalein (5, 6). In a recent article Graham (7) and his collaborators express the opinion that their first unfavorable results with tetraiodophenolphthalein may have been due to an impure product, and mention the possibility that sodium tetraiodophenolphthalein will eventually prove to be a superior medium. They give several reasons, however, why they do not consider this probable and still hold that sodium tetrabromphenolphthalein has definite advantages over the analogous iodine compound as a medium for cholecystography.

In experimental animals we have found (9) that practically twice as much of the bromine as of the iodine salt is required to produce a shadow of the same density and that the toxicity of the two compounds is approximately the same. A comparative test in a human subject evoked a reaction with the bromine but none with the iodine salt. For these reasons we felt justified in the clinical use of sodium tetraiodophenolphthalein and have to date employed this medium for cholecystography in 40 patients. The fact that we have not observed the same degree of toxicity with the iodine compound that Graham and Cole did may, as they suggest, be accounted for by some impurity in their salt. The product we have used in our experiments has been supplied by the Eastman Kodak Company, of Rochester, New York.

METHOD OF ADMINISTRATION

It has been found that 0.045 grams per kilogram of body weight of sodium tetraiodophenolphthalein will cast a distinct shadow of the gall bladder in the normal human subject, and this dose has been used in this series of cases. We are now finding that 0.040 gram per kilogram of body weight gives entirely satisfactory shadows, and that with the few patients in which this amount has been used the reaction to the drug has been negligible.

The quantity of the salt to be injected is weighed out, placed in a clean 100 cubic centimeter flask, and freshly distilled water is added to make a 10 per cent solution. To this is added 1.5 to 2.0 cubic centimeters of a 10 per cent solution of sodium carbonate, which is necessary in order to keep the salt in solution. The solution is filtered, autoclaved at 15 pounds pressure for 30 minutes, and kept well sealed in a dark place. No solution has been used later than 24 hours after preparation.

The injection is given intravenously by the gravity method under low pressure. The tube is filled with normal saline solution, slightly above body temperature to allow for cooling. The needle is then introduced and about 5 cubic centimeters are injected in order to be sure the needle is in the vein. Then the whole of the warmed solution of sodium tetraiodophenolphthalein is poured into the gravity flask and allowed to enter the vein slowly. Contrary to the advice given for the bromine salt, the total quantity is injected at one sitting. This is more convenient for both the patient and the physician. When the flask is nearly empty 25 cubic centimeters of warmed saline solution are added, and this is repeated until the final color of the entering fluid is a very pale blue. The total amount of fluid varies from 125 to 150 cubic centimeters which could hardly produce any ill effect. This dilute solution of the fluid would not be

[1] From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston, Massachusetts. Preliminary report read before the Harvard Medical Society, November 11, 1924.

Fig. 1.

Fig. 2.

Fig. 1 (left). Nine hour film. This gall-bladder shadow was distinctly seen under the fluoroscope.

Fig. 2. Same patient as in Figure 1, after a barium meal. Showing relation of duodenum to gall bladder. Compare with Figure 11.

as irritating to the tissues as a solution more concentrated, should any of it escape from the vein.[1]

MANAGEMENT OF THE PATIENT

The orders for the patient are similar to those given by Graham and his collaborators. The injection is made in the morning, and for the reason that active digestion would interfere with the test, no food should be taken during the first 9 hours, though water *ad libidum* is allowed. After the injection the patient should remain in bed, preferably upon his right side, though this is not essential, and he may sit up or be out of bed if he desires. Roentgenograms are made at the 6, 9, 12, 24, and 36 hour intervals. One half hour before the first, i.e., the 6 hour film, a soap-suds enema with 5 cubic centimeters of turpentine is given to relieve gaseous distention of the colon, and a rectal tube is inserted for 5 minutes prior to each exposure thereafter. After the 9 hour film, cocoa and toast are given to see if food will cause a shrinking in the size of the biliary shadow, for reasons to be discussed later. The patient may have his regular diet the next day.

[1] We are now giving the salt in a 1 to 2 per cent solution in normal saline, the procedure being otherwise the same. By this method we have had only one reaction with headache, chills, and vomiting in a series of 20 cases.

EFFECT OF THE SALT UPON PATIENTS

The action of the compound upon patients seems to vary somewhat and to depend in some degree upon the mental attitude, especially the ability or desire of the individual to co-operate. In 40 cases we have had no serious reactions with sodium tetraiodophenolphthalein. Three of the patients complained of headache and one of these had pain in the back. Two vomited once, one in 10 minutes and the other 30 minutes after injection. A drop of 30 millimeters in blood pressure accompanied by mild cyanosis occurred in 1 case but 1 cubic centimeter of 1:1,000 adrenalin given intramuscularly overcame these symptoms at once. No other case had significant changes in pulse, respiration, or blood pressure following administration. The drug has been given patients with myocarditis and slight decompensation without reaction. Electrocardiograms taken in one case showed no change in any of the leads during or following the giving of sodium tetraiodophenolphthalein.

This is a much lower percentage of reactions than that observed by Carman and Counsellor (2) in the report of a series of patients injected with the bromine salt.

The urine collected for 24 hours following injection in no case showed albumin, sugar, red blood cells, or casts. A 24 hour sample of

Fig. 3.

Fig. 3. Three hour film of normal subject. Gall-bladder shadow is small and faint in outline. This roentgenogram shows the gall bladder of the same patient as that shown in Figures 4, 5, 6, 7.

Fig. 4.

Fig. 4. Six hour film of normal subject. Shadow is larger and denser than that at 3 hours.

Fig. 5.

Fig. 5. Nine hour film of normal subject. Shadow still large and dense.

urine from each patient was alkalinized but no color changes were noted. A blue color should have resulted if unchanged sodium tetraiodophenolphthalein had been present in any amount. In normal dogs, however, and in those with common bile duct obstruction positive tests for iodine in the urine have been obtained by an oxidation reaction (8).

SELECTION OF PATIENTS

There seems to be no absolute contra-indication for the use of sodium tetraiodophenolphthalein unless it be in the case of a patient whose condition is so low as to make any similar procedure dangerous. Its use in intense jaundice is contra-indicated, for the reason that in experimental animals with chemical hepatic degeneration from chloroform (3), or with common bile duct obstruction (8), only ill-defined gall-bladder shadows are obtained, and consequently the test would not be worth while. Injection of the drug under these conditions, however, would probably not be attended by any great danger, because it has been found that in dogs and cats the toxicity was increased only about 25 per cent after ligation of the common bile duct (8). Such a small dose as we have been accustomed to give patients should not be attended with much danger, even in complete biliary obstruction. In short, it may be said that the test may be used without risk in any patient whose general condition would permit operative intervention.

ROENTGENOGRAPHY

The patient is placed face down upon the table. The right arm is extended above the head and the left arm held parallel with the body, head turned to the left. The Potter-Buckey diaphragm and a 30 milliampère radiator Coolidge tube are used. The exposure is made in the costovertebral angle at 20 inches target-film distance. The time varies with the thickness of the patient's body, 3 to 7 seconds being the extent of variation. A 5 inch spark-gap with 30 milliampères of current is used as a routine. As stated above, films are taken at 6, 9, 12, 24, and 36 hours after injection.

Following the suggestion of Dr. E. C. Vogt the gall bladder has been examined under the fluoroscope at the 9 hour period in several cases, and its shadow distinctly seen (Fig. 1). This procedure allows palpation of the gall bladder for tenderness and mobility. In some cases the patients were given barium mixture and the exact relation between the duodenal cap and the gall bladder determined (Fig. 2). The barium, however, obscures the gall-bladder shadows in subsequent plates. For this reason Dr. M. C. Sosman, roentgen-

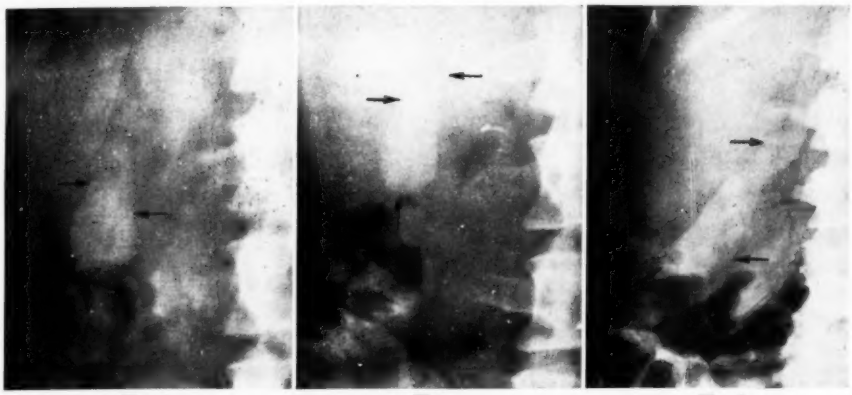

Fig. 6. Fig. 7. Fig. 8.

Fig. 6. Twelve hour film of normal subject. Food was given after the 9 hour film. Note the marked shrinking in size of shadow.

Fig. 7. Twenty-four hour film of normal subject. Shadow has become smaller and less dense.

Fig. 8. Six hour film showing multiple negative shadows which at operation proved to be stones. These negative shadows are within the opaque gall-bladder shadow. Note also the abnormal outline of the shadow as compared with Figures 3, 4, 5, 6, and 7.

ologist at this hospital, believes that two separate examinations will give better results than the combined form.

INTERPRETATION OF SHADOWS

The normal gall bladder begins to cast a shadow at the end of 3 hours after the injection of sodium tetraiodophenolphthalein (Fig. 3), which reaches its maximum intensity during the 6 to 12 hour interval (Figs. 4, 5, 6), and begins to fade in 24 hours (Fig. 7), disappearing entirely in 32 to 36 hours. This chain of events has occurred in 8 normal individuals who have voluntarily submitted to the test. The normal shadow is oval in shape and smooth in outline. It is at first small (Fig. 3), swells to a maximum at 6 to 9 hours (Figs. 4, 5), and then gradually diminishes in extent. After food a quick reduction in the size of the shadow has been noted which probably indicates a sudden contraction of the gall bladder and outpouring of bile for digestion (Fig. 6). We interpret this contraction after feeding as diagnostic evidence of a normal gall bladder and consequently after the 9 hour film usually give food as a test of normal function.

Pathological conditions of the gall bladder have been indicated by a variety of features. Failure to obtain a shadow of the gall bladder has occurred in 9 out of 20 cases that have been submitted to operation. Eight of these had indisputable block of the cystic duct by a stone or an obliterative inflammatory reaction. One instance in which a shadow was obtained only in the 12 hour plate was in a patient who had quite marked chronic

Fig. 9 (left). Six hour film showing gall-bladder shadow containing two negative shadows. The smaller indicated by two lower arrows, probably represents a stone. The other negative shadow, indicated by upper arrow, overlapping the lower one slightly, represents gas in the colon.

Fig. 10. Nine hour film on same patient as in Figure 9. The smaller negative shadow, presumably stone, has changed its position since the 6 hour film (arrow). The negative shadow due to gas has disappeared.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 11. Six hour film showing a negative shadow which proved to represent a gas filled duodenum (arrows) distorting gall-bladder shadow by pressure. Compare with Figure 2.

Fig. 12. Plain film showing two dense shadows, (a) and (b), the larger one (b) in the region of the kidney. The kidney outline is indicated by the lower arrow.

Fig. 13. Same patient as in Figure 12. After injection of sodium tetraiodophenolphthalein no distinct gall-bladder shadow was brought out such as is ordinarily produced by the salt. This was good evidence that the cystic duct was closed and indicated that the gall bladder was pathological and that the two constant shadows (a) and (b), represented almost certainly gall stones instead of kidney stones. At the time of operation, the upper shadow (a) proved to represent a stone blocking the cystic duct, and the larger shadow (b) a mass of gall-bladder sand. The two lower arrows show the outline of the kidney.

cholecystitis, although the cystic duct was open and there were no stones present. This last case seems to exemplify the point brought out by Graham and his collaborators (5) that the concentrating power of the gall bladder must be active to permit visualization of the organ. Hence, in high-grade cholecystitis, even though the cystic duct be open and the lumen of the gall bladder patent, if this concentrating function were absent no shadow should be obtained. Judging from the foregoing cases it would appear that a failure to obtain a shadow of the gall bladder, provided the technique described is followed, is very good evidence of a pathological condition in the biliary system.

The presence of gall stones in 2 patients was indicated by "negative" shadows within the opaque gall-bladder shadow which persisted through the entire series of films (Figs. 8, 9, and 10). These findings were verified at operation. In one of these cases a single large "negative" shadow was seen which occupied different positions in different films, suggesting a freely movable stone (Figs. 9 and 10). Ring shaped shadows were seen only in the 24 hour film of 1 case, which did not show a distinct gall-bladder shadow. These proved to represent multiple stones in a small gall bladder markedly thickened by chronic inflammation. These calculi were not seen in the plain films and we believe some of the salt was deposited upon them.

Variations from the normal in the shapes of the gall-bladder shadows are also met with. In 1 case an irregular shadow was interpreted as evidence of chronic cholecystitis with adhesions and proved to be such at the operation. Another factor which may distort the contour of the gall bladder is a dilated duodenum filled with air. This condition, the result of an abnormal superior mesenteric artery, was discovered in 1 case at the time of operation (Fig. 11). Gas in the colon also may produce indentations in the gall-bladder shadow (Figs. 1, 5, and 9).

In many cases, cholecystography may be of value in differential diagnosis of conditions both within and without the gall bladder. For example: In 1 patient two opaque oval shadows were seen in the right costovertebral angle on the plain film (Figs. 12, *a* and 12, *b*). The larger of these was properly placed for a stone in the region of the kidney (Fig. 12, *b*). After the administration of sodium tetraiodophenolphthalein there was no indication

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 14. Nine hour film showing constriction of the gall-bladder shadow. Same patient as in Figures 15 and 16.

Fig. 15. Twelve hour film still showing constriction, but a shrinking in size after food of the gall-bladder shadow in Figure 14, indicating no intrinsic pathological condition of the gall bladder.

Fig. 16. Twenty-four hour film still showing the same constriction of the shadow as in Figures 14 and 15, but also the normal features of decrease in size and density of the shadow. There is probably in this case a peritoneal adhesion exerting pressure upon a gall bladder otherwise normal.

of the normal gall-bladder shadow ordinarily produced by the salt. This was good evidence that the cystic duct was closed, since in 8 out of 9 cases in which no shadows were obtained an occlusion of the cystic duct was present. The test in this case was interpreted to mean that the gall bladder was pathological and that the two shadows in question were concerned with it. At the time of operation a stone was found in the cystic duct (Fig. 13, *a*) of a contracted gall bladder filled with sand (Fig. 13, *b*).

Likewise, the possibility of detecting pathological conditions outside the gall bladder may be illustrated by another case. A median constriction of the gall-bladder shadow which was constant in all plates is shown in Figs. 14, 15, 16. The varying size of the gall-bladder shadows at different periods, however, indicated contractile and expansile power, comparable to that of a normal gall bladder. Such a distortion of the shadow due probably to some extraneous condition such as a peritoneal band is obviously an important factor which must be considered in the interpretation of gall-bladder shadows.

There are several other findings the exact significance of which is still problematic. In some cases very faint shadows were noted only in the late plates. In the absence of any demonstrable disorder of the liver, this would seem to indicate cholecystitis, though rapid emptying of the organ is also possible as the cause. The persistence of a shadow beyond 36 hours in all probability indicates stasis.

In the appended table we have listed the cases in which the actual condition of the gall bladder has been proved by exploratory laparotomy. All of the 20 cases had very definite histories that led to the clinical impression of chronic cholecystitis with or without stones. The interpretation of the cholecystograms was erroneous in only one case (5 per cent) while the clinical impression was not correct in 35 per cent of the cases. The 1 case in which diagnosis from cholecystography failed was that in Figure 11 in which pressure of a dilated duodenum distorted the gall-bladder shadow. We now recognize that this is a condition to be taken into consideration and we probably would not make the same mistake again.

Our diagnostic results with sodium tetraiodophenolphthalein for cholecystography agree in general with those of Carman and Counsellor (2) who have employed the sodium salt of tetrabromphenolphthalein for this purpose.

We believe that such a remarkable advantage of cholecystography over clinical

TABLE OF PROVED CASES

	P.B.B.H. Surgical Number	Shadow before Injection	Shadow at Hours 6	9	12	24	36	Diagnosis from Cholecystograms	Postoperative Diagnosis
1	22652	○	○	○	○	○	○	Cholecystitis—block of cystic duct	Chronic cholecystitis—block of cystic duct.
2	22365	○	+	+	+	+	○	Chronic cholecystitis, multiple stones	Chronic cholecystitis—many stones.
3	22425	○	+	+	+	+	○	Chronic cholecystitis, one stone	Chronic cholecystitis—one large stone.
4	22401	○	+	+	+	+	○	Distorted shadow—(?) chronic cholecystitis	Dilated duodenum, by superior mesenteric artery, with pressure on gall bladder, otherwise normal.
5	22533	○	○	○	○	○	○	No shadow—block of cystic duct	Chronic cholecystitis with stones—cystic duct block.
6	22447	○	○	○	○	○	○	No shadow—block of cystic duct	Severe chronic cholecystitis with cystic duct block.
7	22407	○	○	○	○	○	○	No shadow—block of cystic duct	Severe chronic cholecystitis with cystic duct block
8	22352	○	○	○	+	○	○	Pale and distorted shadow. Chronic cholecystitis	Fibrosed and contracted gall bladder.
9	22524	○	+	+	+	+	○	Well filled gall bladder of normal outline	Duodenal ulcer—gall bladder normal.
10	22680	○	○	○	○	○	○	No shadow—block of cystic duct	Marked chronic cholecystitis—cystic duct closed.
11	22737	○	○	○	○	+		Multiple ring shadows in late plates. Gall stones	Multiple gall stones in the remains of a gall bladder drained one year before.
12	22761	+	+	+	+	+	+	Stone in plain plate. No change in shadow after injection	Block of cystic duct by stone. Inspissated bile.
13	22895	○	○	○	○	○	○	No shadow—block of cystic duct	Multiple stones—stones in cystic duct.
14	22882	○	+	+	+	+	○	Smooth outline—normal	Normal—interval appendix.
15	22898	○	+	+	+	+	○	Smooth outline—normal	Normal gall bladder, pelvic inflammation.
16	22775	○	+	+	+	+	○	Smooth outline—normal	Gall bladder normal. Pericolitis.
17	22867	○	○	○	○	○	○	Block of cystic duct	Chronic cholecystitis—many large and small stones.
18	22926	○	○	○	○	○	○	Closure of cystic duct	Marked chronic cholecystitis with stones—cystic duct closed.
19	22997	○	+	+	+	+	○	Smooth outline—normal	Gall bladder normal. Pelvic inflammation.
20	23027	○	+	+	+	+	○	Smooth outline—normal	Gall bladder normal. Duodenal ulcer.

methods of diagnosis, together with its very slight inconvenience to the great majority of patients and apparent lack of danger, justifies its routine use in cases in which there is any question of the diagnosis.

SUMMARY

Experience both in laboratory and clinic indicates that sodium tetraiodophenolphthalein is a safe and satisfactory drug for the purpose of cholecystography. We believe that the evidence presented in this and a previous paper (9) demonstrates its superiority over sodium tetrabromphenolphthalein.

We have had only four reactions severe enough to cause headache or vomiting in our series of 40 cases.

In this paper comment is made upon the use of fluoroscopy, and of a combined examination of the gall bladder with the stomach and duodenum by use of the barium meal 9 hours after the injection of sodium tetraiodophenolphthalein.

The conditions indicating pathological gall bladders have been (1) failure to produce a shadow due to cystic duct obstruction or severe chronic cholecystitis, (2) gall stones which are not seen in the plain films but show as "negative" shadows in the cholecystograms, (3) failure of the normal expansion and contraction of the gall bladder, and (4) distortion of the shadow due to causes in or about the gall bladder.

The diagnosis of pathological conditions of the gall bladder by means of cholecystography has been found to be correct in 95 per cent of the series of proved cases, while the clinical impression was correct in only 65 per

cent. Thus, this new principle of Graham and Cole provides a measure of great accuracy in the diagnosis of disorders of the biliary system.

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GASTRIC TETANY; A FATAL CASE

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GASTRIC tetany is a comparatively uncommon condition. The importance of early diagnosis from blood findings, before the clinical symptoms are manifest, cannot be overstressed. The indication for operative relief must be made early in order to give the patient a fair chance. The first report of gastric tetany was made by Neumann in 1861, but it remained for Kussmaul to present a complete and accurate description of the condition and place it on a firm clinical basis.

DEFINITION

Gastric tetany is a condition manifested by persistent vomiting, tonic cramps, usually bilateral, starting in the fingers and toes and progressing centrally, with a pyloric obstruction as its underlying pathological cause.

Von Frankl-Hochwart has conveniently classified tetany into six groups: (1) idiopathic, (2) gastric and intestinal, (3) acute infectious (cholera; typhoid, scarlet, or rheumatic fever; malaria, sore throat, influenza), (4) intoxications and poisons (ergotin, alcohol, chloroform, uræmia), (5) pregnancy, and (6) parathyroidectomy.

The gastric type is of particular interest, for the underlying cause of the obstruction is usually benign in character and amenable to surgical intervention. The importance of operative intervention in the relief of the obstruction will be seen by the considerable decrease in the mortality since this form of treatment has been instituted.

OCCURRENCE

Boas quotes Gumprecht who had collected 40 cases. This represented a complete review of the literature to 1897. To this group he adds 12 cases. Hirschberg states that but 50 cases were reported up to 1911. Edward's series of 101 cases represents the largest collection. Since 1908, there have been but 15 cases reported in the literature.

PATHOLOGY

The pathological conditions causing gastric obstruction in these cases are many, but the larger number are due to a cicatricial obstruction at the pylorus, most commonly a chronic ulcer. A few cases have followed pyloric carcinomata. Fleiner reports a case of sarcoma at the pylorus causing obstruction and subsequent tetany. Other conditions which have caused gastric obstruction with tetanic manifestations are torsion of the stomach (Mueller), compression of the duodenum by a pancreatic cyst (Berlitzheimer), compression of the duodenum by a gall bladder filled with stones (Blazicek), and foreign bodies in the stomach (Warbasse). Four cases of spasm of the stomach have been reported as giving rise to tetany without any apparent organic lesion. Rodman reports a case of gastric tetany coming on 11 days after a gastroenterostomy.

PATHOGENESIS

An attempt to explain the appearance of tetany in cases of gastric obstruction has stimulated a large amount of experimental work, but up to the present we are uncertain as to the exact causative factor. Kussmaul attributed the convulsions to the loss of large quantities of fluid with resultant desiccation of the tissues. While there is considerable loss of fluid in many cases, this cannot be supported in view of the experimental production of tetany with the maintenance of the fluid balance by introducing fluid into the duodenum below the site of obstruction. After this procedure, tetany still develops. Mueller and Riegel sponsored a reflex irritation theory as a cause of the spasm, but this is purely theoretical and has no experimental support.

Bouchard maintained that the spasms were due to an absorption of toxic products from the obstructed stomach. A number of investigators have isolated substances from

cases of gastric tetany and by means of animal experimentation sought to prove the cause of the spasms. Bouveret and Devie isolated peptotoxins and Kulneff diamins from the stomachs of cases with gastric tetany. These investigators were able to produce convulsions in some animals with these isolated toxins, and sometimes death followed. Alkaloidal bodies have been recovered from the urine during an attack of tetany. On injection into animals, these urinary alkaloids have produced tonic convulsions.

Other attempts were not so successful. For example, Fleiner and Gottlieb utilizing the peptotoxins of Bouveret and Devie produced clonic contractions quite unlike those seen in cases of tetany. Halliburton, Gumprecht, and McKendrick working with products isolated from the stomach and urine were unsuccessful. Moreover, Cassaet and Ferre were able to produce convulsions in animals with substances isolated from the normal stomach.

MacCallum and Murray have shown that after experimental occlusion at the pylorus, tetany may be initiated by frequent stomach lavage. This would not appear to support the view that tetany was induced by toxic absorption, but rather a loss of substance which disturbs the body equilibrium in such a manner as to initiate the tetanic state.

Murray, more recently, gives an exposition of the chemical pathology of gastric tetany with experimental and clinical data to explain his conception of the pathogenesis. He states that there is a persistent loss of hydrochloric acid due to the constant vomiting, with resultant disturbance of the composition and physicochemical properties of the blood. These blood changes affect the peripheral nervous system particularly, causing a progressive increase in its irritability. He has observed a rise in the carbon dioxide combining capacity of the plasma, a fall in the chloride content of the whole blood and plasma, increased sulphur and phosphorus concentration, a slight rise in the hydrogen ion concentration, and an increased blood urea.

The persistent loss of hydrochloric acid from the body by vomiting means a loss of the H and Cl ions from the blood. The loss of $H+$ ions releases $-HCO_3$ ions and the loss of $-Cl$ ions releases $Na+$ ions. The combination of these freed ions gives $NaHCO_3$ which results in an increased total carbon dioxide of the plasma. The increased carbon dioxide content or capacity, that is, over 80 per cent, in cases without a history of alkali therapy, is a very important diagnostic sign in cases of gastric obstruction. This increased carbon dioxide content is present before the onset of any signs of tetany and gives an indication for early operative interference.

SYMPTOMATOLOGY

All the symptoms and signs of the motor insufficiency of the stomach, whatever be its underlying pathological cause as mentioned above, are present with the additional manifestations of tetany.

The onset of the tetanic spasms, usually sudden, may be initiated by any muscular activity, such as vomiting, stomach wash, or even examination of the patient. Beginning as a rule in the upper extremity and affecting the flexor muscles, there is flexion of the fingers at the metacarpophalangeal joints and the thumb is markedly adducted. The wrist is flexed and the whole picture is that of the "obstetric hand" described by Trousseau. The elbow may be flexed and the arm pressed to the side of the body. The extensor muscles are occasionally involved with the result that varied and unique attitudes of the upper extremities occur.

The lower extremities present plantar flexion of the toes, the big toe being abducted beneath the others with a hollowing out of the foot, giving an appearance somewhat similar to that of the hand. The heel is raised giving a pes equinus. Only exceptionally are the muscles of the thigh and hip involved.

These spasms may last from a few minutes to a few hours.

Trousseau has designated three types of cases depending on the distribution of the muscles involved. A mild form in which only the muscles of the extremities are affected; a moderate form in which the trunk, abdominal, and facial muscles are involved; and a third severe type affecting the muscles of the larynx, pharynx, and tongue.

DIAGNOSIS

The appearance of any spasm in a case of pyloric obstruction should lead one to suspect the presence of tetany. There are objective phenomena which aid materially in establishing a positive diagnosis.

1. Erb's phenomenon. There is a decided increased irritability of the motor nerves to the galvanic current, while the faradic reaction is sometimes increased. This increased irritability is perhaps the most diagnostic objective sign of tetany.

2. Trousseau's sign. Pressure upon the main nerves or blood vessels brings on a tetanic spasm. The test is most easily elicited in the upper extremity by pressure above the elbow sufficient to obstruct the radial pulse. In 1 or 2 minutes, typical tetanic contractions appear, and the hand may assume the characteristic position of carpopedal spasm.

3. Chvostek's sign is an increased irritability of the peripheral nerves to mechanical irritation, particularly the facial nerve. If the facial nerve or any of its branches be percussed at about the middle of the cheek, short rapid twitches of the muscles supplied by the stimulated nerve branch appear.

4. Schlesinger's leg phenomenon. With marked flexion of the hip joint and extended knee, there occurs after 2 minutes an extensor cramp of the knee joint if the foot is forcibly supinated.

Positive reactions to the foregoing tests assist in establishing a diagnosis of tetany. The presence of any one of them, in a case of pyloric obstruction makes a diagnosis of gastric tetany certain.

PROGNOSIS AND TREATMENT

The medical treatment of gastric tetany is very unsuccessful with a mortality ranging from 70 to 90 per cent. Since the advent of surgery for its relief, the mortality has been reduced to about 37 per cent.

Tetany can be prevented by the early operative relief of the pyloric obstruction. The carbon dioxide capacity of the blood should be determined and if it exceeds 80 per cent by volume, immediate operation is imperative, provided there has been no history of extensive alkali therapy. A gastro-enterostomy will relieve the obstruction and forestall the development of tetany. Murray states that if the carbon dioxide content of the blood plasma continues to rise above 80 per cent, one can predict tetany. In his cases the carbon dioxide content of the blood plasma was over 100 per cent by volume before the onset of tetany.

If tetany has developed, gastro-enterostomy is the procedure of choice and this should be done early.

On the basis that the tetanic condition in these cases is brought about by the loss of hydrochloric acid, the rationale would be to introduce acid to combat the condition. Murray infused a combination of 500 cubic centimeters of N/10 hydrochloric acid solution with a similar amount of N/0.15 salt solution without harmful effects. Calcium chloride has also been administered in these cases without striking results.

Until further work has been done to establish the exact cause of tetany in cases of gastric obstruction, operation for the relief of the obstruction offers the best hope for recovery.

The following case is taken from the records of Beth Israel Hospital to illustrate the symptomatology and a fatal outcome because the operation was deferred.

R. B., female, 60, has had a history of epigastric discomfort for the past 3 years, with occasional attacks of severe pain in the upper abdomen accompanied by vomiting. During one of these attacks which occurred 3 weeks ago, she was removed to a city institution. Here a roentgen examination disclosed a chronic gall-bladder condition and operative interference was advised. The acute symptoms having abated, the patient refused operation and left the hospital. After leaving the hospital, there was no recurrence of pain, but the vomiting persisted.

Three days ago, she suffered from severe abdominal cramps, and the vomiting became continuous. Vomitus consisted of greenish and at times turbid fluid. A diagnosis of cholelithiasis was made by the family physician who called Dr. J. Barsky in consultation to decide whether operation should be undertaken. A history of intermittent painful contractions of the fingers and toes with the typical "obstetric hand" was elicited. A diagnosis of gastric tetany was made and the patient removed to Beth Israel Hospital.

Examination shows an adult white female, about 60, *in extremis*. Face and finger nails are cyanosed.

Extremities are in almost constant carpopedal spasm. Chvostek's sign elicited. Tongue is dry and coated. Chest is emphysematous in type. Breath sounds are diminished and few moist râles are present throughout the lung. Heart is enlarged and the sounds are of poor quality. Abdomen is distended; more marked in the upper half. Liver is palpable two fingers below the costal margin. Temperature 100, respiration 42, pulse 116, irregular and weak. Blood pressure 114–76. Wassermann negative. A stomach wash was given and one quart of dark brown turbid fluid removed on insertion of stomach tube. The carpopedal spasms continued unabated, the patient dying 12 hours after admission to the hospital.

The autopsy was incomplete. The liver was torn and macerated on removing. The gall bladder was not removed. The liver presented no pathological changes. The stomach was dilated to twice its normal size. No evidence of ulcer or new-growth was present. Intestines and duodenum normal. Peritoneum normal. Kidneys normal. The pathological condition was evidently associated with the gall bladder which was unfortunately not removed.

Anatomical diagnosis: dilatation of the stomach.

CONCLUSIONS

1. Gastric tetany is an infrequent condition and is fatal if not treated early and properly.

2. It is preceded by an obstruction at the pylorus usually of a benign character, e.g. ulcer.

3. An increased carbon dioxide combining capacity of the blood plasma ranging from 80–100 per cent preceded the onset of the tetanic spasms.

4. The obstruction should be relieved by a gastro-enterostomy before the manifestations of tetany appear, thus preventing an extremely dangerous complication.

5. If tetany ensues, gastro-enterostomy is the treatment of choice.

I wish to express my sincerest thanks to Dr. J. Barsky who has so kindly granted me permission to report the case.

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HÆMATOGENOUS OSTEOMYELITIS

Report of a Group of Seventy-One Cases

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THIS report is based upon an analysis of all the cases of pyogenic infection of bone due to acute hæmatogenous osteomyelitis which have been admitted to the Children's Surgical Service of Bellevue Hospital during the past 4 years. Because of the age limit of this service, none of these patients was over 12½ years old when admitted.

The majority of the patients came to the hospital with a history of having been ill for from 3 days to 3 weeks and therefore did not present lesions of the earliest stage of the disease when simple surgical drainage would have been sufficient to effect an early cure.

The clinical picture presented by the acute cases was that of an extremely sick child, profoundly septic, with a temperature varying from 103 to 105 degrees, or even higher. The extremity was red and œdematous over the upper or lower half of the bone involved, and often over its entire length. Tenderness, which as a rule denotes subperiosteal inflammation over the infected bone, could always be elicited, and it was not confined to a single point but often extended up and down the bone for several inches. Fluctuation in the soft tissues was not uncommon.

The diagnosis in most cases was perfectly obvious. The problem which confronted us was this: How much or how little operative surgery was necessary in these cases to save life and effect a cure?

There were 71 cases in all, 44 boys and 27 girls, a ratio of 3 to 2. Only 3 cases occurred during the first year of life, and but 20 children were under 5 years of age, and 19 between 10 and the age limit of 12½ years. This shows an increase as adolescence approaches.

For the purpose of this paper, the series has been divided into 2 groups—first, the acute cases, 42 in number; and, second, the subacute or chronic cases, 29 in number, who had received some form of surgical treatment prior to their admission to the hospital. Their acute symptoms had subsided, and they presented discharging sinuses, which led to dead bone, this condition having been present as a rule for several months.

TABLE I.—AGES IN 71 CASES

ACUTE CASES

	Cases	Per cent
Male	30	71.5
Female	12	28.5
Total	42	

Ages in years	Acute cases	Per cent
Under 1 year	1	2.56
1 to 2	2	5.12
2 to 3	2	5.12
3 to 4	3	7.68
4 to 5	2	5.12
5 to 6	1	2.56
6 to 7	5	12.80
7 to 8	4	10.24
8 to 9	5	12.80
9 to 10	6	15.00
10 to 11	4	10.24
11 to 12	7	17.92

CHRONIC CASES

	Cases	Per cent
Male	14	48
Female	15	52
Total	29	

Ages in years	Chronic cases	Per cent
Under 1 year	2	7
1 to 2	0	0
2 to 3	2	7
3 to 4	4	4
4 to 5	2	7
5 to 6	3	10
6 to 7	0	0
7 to 8	2	7
8 to 9	2	7
9 to 10	4	14
10 to 11	5	17
11 to 12	3	10

Among the etiological factors, a recent furunculosis, tonsillitis, or otitis media has often appeared to be the primary source of infection. One case appeared to be secondary to acute appendicitis with abscess. A history of some form of local trauma was very common, and occasionally the disease seemed to be secondary to exposure to cold and wet.

The organisms found in the specimens of pus examined were, in the order of their frequency, staphylococcus aureus, streptococcus hæmolyticus, and staphylococcus albus, the staphylococcus aureus being present in 86 per cent of the cases.

TABLE II.—ORGANISM FOUND

PUS

		Per cent
Staphylococcus aureus	18	70
Streptococcus hæmolyticus	3	11
Staphylococcus albus	1	4
Negative	4	15
Total	26	

BLOOD

		Per cent
Staphylococcus aureus	5	25
Streptococcus hæmolyticus	1	5
Negative	13	70
Total	19	

The bone most frequently affected was the tibia which was involved in 30 cases. The infection began in the lower end of the diaphysis of the tibia in 18 cases. This was the most common primary site. The lower end of the femoral diaphysis was the next in frequency. There were 14 such cases. The humerus was involved primarily in 7 cases, the infection beginning in the upper end of the diaphysis. The lower end of the diaphysis was never involved primarily. In 11 cases, several bones were infected, either primarily or as subsequent lesions. In our experience, primary infection of the humerus was the most serious condition, for of the 7 cases reported, 3 patients died, and 3 had other bones infected subsequently, while 1 developed a pyopericarditis. The 3 fatal cases showed positive blood cultures, in 2 of which the staphylococcus aureus was present, and in 1, the staphylococcus hæmolyticus aureus.

In discussing the method of treatment in the acute cases, the duration of illness before operation must be borne in mind. The majority of these cases were not diagnosed as acute osteomyelitis until a considerable period of time, varying from 3 days to 3 weeks, had elapsed after the onset of the symptoms, and it was not until the infection had gained very considerable headway that they were referred to the hospital for surgical intervention. We never had a case in the early stage when simple methods, such as incision of the periosteum, seemed adequate.

TABLE III.—PART INVOLVED PRIMARILY

	Upper diaphysis	Lower diaphysis	Middle diaphysis
Tibia	11	18	0
Femur	3	14	0
Humerus	7	0	1
Fibula	3	1	0
Radius	0	1	0
Ulna	3	3	0

TABLE IV.—THE BONE AFFECTED

	Acute cases	Per cent	Chronic cases	Per cent
Right tibia	11	27	5	17.2
Left tibia	11	27	3	10.5
Right fibula	1	2.5	0	0
Left fibula	3	7.5	0	0
Right femur	4	10	3	10.5
Left femur	6	15	5	17.2
Right os calcis	1	2.5	2	6.8
Left os calcis	1	2.5	1	3.4
Right ischium	1	2.5	1	3.4
Left ischium	0	0	2	6.8
Right ilium	0	0	1	3.4
Left ilium	0	0	1	3.4
Right ulna	3	7.5	2	6.8
Left ulna	1	2.5	0	0
Right radius	0	0	1	3.4
Left radius	0	0	0	0
Right clavicle	0	0	0	0
Left clavicle	0	0	1	3.4
Right humerus	3	7.5	3	10.5
Left humerus	2	5	0	0
Right scapula	0	0	1	3.4
Left scapula	0	0	0	0
Right mandible	0	0	1	3.4
Left mandible	0	0	1	3.4
Metatarsals (secondary)	1	2.5	2	6.8
Multiple bones	5	12.5	5	17.2

Usually the skin over the infected area was tense, œdematous, and glazed, resembling a cellulitis, and frequently, when the soft tissues were incised, pus was immediately encountered. Periosteum was found ruptured, and elevated for several inches, or over the entire length of the diaphysis. The bone cortex was often necrotic for a variable length. The condition was that of an extensive infection of the bone and soft tissues.

In 26 cases part of the bone cortex was removed. By this is meant that after the periosteum had been reflected, one to several inches of the bone was chiseled away, exposing the medullary cavity. The extent of the removal was determined by the amount of

infection of the cortex and purulent condition of the medulla. Only sufficient bone was removed to provide for adequate drainage and Dakinization of the infected medullary cavity. The medullary cavity was never vigorously curetted, but any purulent material present was removed with gentle sponging. Conservative treatment, such as incising and enlarging the opening of the already ruptured periosteum, was at first attempted in many of these cases without apparent relief, and subsequently it was necessary to remove part of the cortex to establish proper drainage. The medullary cavity and soft tissues were thoroughly and continuously Dakinized until all sign of infection had disappeared. Eighteen of these cases showed purulent areas in the medulla, and in 5 others the cortex was soft and necrotic for several inches.

The removal of the cortex, except by drilling or curetting a small opening, is not advocated in the early stage of osteomyelitis. In cases in which the duration is a week or more and in which often almost the entire length of the medullary cavity with a corresponding area of the cortex is infected, a small opening of ½ to 1 inch does not afford sufficient drainage, and, as the bone later sequestrates, no harm can be done by the removal of a potential sequestrum at operation. We believe that the earlier surgical drainage is instituted, the less the destruction of the cortex, and, if drainage is established in the first 24 to 36 hours after the onset by splitting the periosteum and drill ng the cortex with a small hole or two, there is comparatively little destruction of bone, and convalescence is shortened.

In 4 cases the cortex was drilled with several medium sized holes after the periosteum was incised. Subsequently more cortex was removed to provide sufficient drainage in 1, and amputation was necessary in another to save the patient's life. In 10 cases, a small amount of necrotic bone was removed with a curette. These cases were admitted a few days after the onset of the disease or before much bone destruction had occurred. The convalescence averaged 4 months.

The lower third of the fibula was resected in 2 cases. The bone regenerated in about 1 year. The epiphysis was destroyed in 1, and ankylosis of the ankle finally resulted.

Amputation was done in 3 cases. The infection had occurred in the femur in 2 cases in which several inches of cortex had been previously removed; and in the tibia in 1 case in which the cortex had been previously drilled with several large holes. A guillotine amputation was performed in each case and the stump Dakinized. All the patients improved immediately after operation, and all recovered. One developed acute mania which cleared up in 24 hours after amputation, and another had a positive blood culture with infection of 2 other bones. No limb was sacrificed except to save the patient's life.

Two cases showed partial destruction of the lower epiphysis of the tibia. In each case the more rapidly growing fibula caused the foot to be inverted, one moderately, the other to such an extent that 2 inches of the shaft of the fibula was removed subperiosteally, in the endeavor to check the deformity and afford opportunity for the epiphysis of the tibia to regenerate. At present the foot is considerably inverted, but with a corrective shoe the patient walks fairly well.

Thirteen cases (31 per cent of our series of acute cases) were transfused with whole blood by the Linderman method. The number of transfusions in the individual cases ranged from 1 to 12. All cases that do not show marked improvement after operation are transfused, repeatedly if necessary.

In subacute or chronic cases, the treatment necessarily differs from that outlined above. Many of the children had received surgical treatment elsewhere, and the condition was often of months' duration before the patient was admitted to Bellevue Hospital. These children had discharging sinuses, tender enlarged bones, bone cavities or sequestra.

In 16 of these cases the sinuses were incised and the bone cavities gently curetted and necrotic bone removed. The entire shaft of 1 ulna and of 1 tibia was resected subperiosteally. The ulna has not regenerated in 4 years, pronation and supination are lacking. The extension of the elbow is limited 20 degrees. In the case in which the tibia was involved the leg had to be amputated. In 6

TABLE V.—TREATMENT

	Acute	Chronic
Bone cortex removed	26	0
Bone drilled	4	0
Bone curetted	8	16
Bone resected (subperiosteally)	4	1
Sequestrum removed	0	6
Incised and drained	0	6
Total	42	29

Sequestra	40	per cent
Transfusions	27.5	per cent (13 cases)
Amputations	3	(acute)

Age in years			
5		Left tibia	
		Left femur	Bone cortex removed
6½		Left tibia	Drilled
10		Left femur	Bone cortex removed
12	(1 chronic)	Right tibia	Resected

cases the sinuses were enlarged and only the bone sequestra were removed. In 6 other cases the soft tissues were incised and ample drainage instituted. Sequestra were removed in 40 per cent of the total cases, either at operation or by subsequent extrusion through the sinuses.

Eight patients in the acute series died, giving a mortality of 19 per cent. In 5 cases a positive blood culture was obtained, and the other 3 gave symptoms of septicæmia but died in 3 hours after admission before blood cultures were obtained.

Two developed a pyopericarditis which was opened and drained. Another had foci of infection in the tibia, fibula, and ulna together with a chronic endocarditis.

One death occurred in the chronic series of cases. This child was in such an emaciated condition upon entrance to the hospital that all supportive treatment failed. The entire shaft of the femur was involved and the child's condition did not warrant a high amputation.

Twenty-eight of the acute cases are healed. The average duration of the complete recovery was 11.4 months. The average case was followed about 2 years.

No case was considered healed until the epithelium had completely regenerated and remained intact for a number of months, and the radiograph showed a bone free of sequestra and rapidly approaching normal.

TABLE VI.—DURATION AND PROGNOSIS

ACUTE CASES

Duration Months	Healed Cases	Unhealed Cases	How long followed Years
3	4	..	..
6	7	..	..
9	6	1	1
12	4	..	6
18	1	..	3
24	6	1	8
36	0	1	14
48	0	2	1
Died	8	10 per cent	
Average duration	11.4 months		

CHRONIC CASES

3	..	..	..
6	4	3	4
9	1	..	2
12	7	..	6
18	3	1	2
24	3	2	8
36	2	1	6
48	..	1	1
Died	1	3.6 per cent	
Average duration	15.5 months		

ACUTE UNHEALED CASES

Duration Months	Bone involved	Age of child Years	Treatment
9	Right tibia	8	Drilled and curetted
26	Left tibia	8	Guttered
38	Left femur, tibia, humerus	5	Guttered—leg amputated
42	Left tibia	9	Curetted
48	Both tibiæ. Both humeri	9	Guttered

CHRONIC UNHEALED CASES

Duration	Bone involved	Age of child Years	Treatment
3 months	Right humerus	2½	Incised (disappeared)
6 months	Both femora	3	Incised (lues)
9 months	Right os calcis	5	Curetted
1 year	Left femur	4½	Curetted
1½ years	Right mandible	2	Sequestrum removed
2 years	Left tibia	3	Curetted
2 years	Left femur	3	Sequestrum removed
4 years	Right tibia	8	Resected subperiosteally

ACUTE FATAL CASES

		Culture
2 months	Right tibia	None
2 years	Right humerus	Blood and pus—staph. aureus
3 years	Left femur	None
3½ years	Left humerus	Blood and pus—staph. aureus
6 years	Left tibia, fibula, ulna	Blood and pus—strept. hæmolyt.
9 years	Right tibia	Pus—staph. aureus
9 years	Left humerus	Blood and pus—staph. hæmolyt.
10 years	Left femur, left fibula	Blood and pus—staph. aureus

CHRONIC FATAL CASE

11 years	Right femur	

Tibiæ from which several inches of cortex had been removed required the longest time to heal, an average of 20 months. The bone usually regenerated in about 9 months, but the new epithelium over the scar refused to remain intact and abraded under the slightest provocation. These cases were not considered healed until the epithelium was firm and sound for several months.

The average time required for healing in the other bones in which the cortex had been removed was 9½ months.

The cases that required only curetting healed on an average in 4 months.

Of the 4 cases in which the cortex was drilled with several medium sized holes, one required 12 months and another 24 months for complete recovery. In the third proper drainage could only be established by further removal of the cortex, and in the fourth, amputation of the limb was necessary.

Twenty-one of the subacute or chronic cases are healed. The average time from onset until complete recovery was 15.5 months.

The condition of the 6 unhealed cases in the acute series is as follows:

One could not be located after 9 months. This case has a moderately infected tibia. There was only a small wound at that time and the condition probably healed in about 3 months.

The second case, in which about 2/3 of the tibia was involved, still has a granulating wound over the scar, which heals and breaks down although the radiograph shows no sequestra and apparently healthy bone. This case has been followed 26 months.

In the third case, the entire shaft of the left femur, the lower third of the left tibia, the right tibia and the humerus were affected. The left leg was amputated at the upper third of the thigh. This patient had a positive blood culture. The original foci of infection had healed but several other foci, such as a suppurative elbow joint, and a periostitis of the opposite humerus, have developed subsequently. The patient is apparently well at present, but he is not considered cured. This child has been followed for 40 months.

The fourth case presented involvement of the entire tibia shaft at operation. The periosteum was ruptured and the bone presented a worm-eaten appearance. The epithelium over the scar has a tendency to break at varying intervals. This case has been followed for 44 months.

In the fifth case there was an infection of both tibiæ on admission to hospital, and subsequently both humeri. This patient is at present recovering from a suppurative arthritis of the right knee and therefore is not considered healed, although the bones have ceased to show any disease for some months. This case has been followed for 48 months.

The sixth case had a severe infection of the entire shaft of the left tibia at the time of operation. The periosteum was incised over the length of the diaphysis. Two months later the entire diaphysis became sequestrated and was removed. The two fragments show no tendency to unite, and a bone graft will probably be necessary to restore the tibia. This case has been followed 15 months.

The condition of the 8 unhealed chronic cases is as follows:

In one the infection disappeared after 3 months. A second showed a positive Wassermann and at the end of 6 months was under treatment at another hospital for syphilis. An infected os calcis after 9 months, 2 femora after 1 and 2 years respectively, and a mandible after 1½ years, still have discharging sinuses. There is no sequestrum in the radiographs of these cases.

The epithelium over the scar of 1 tibia still has a tendency to abrade after 2 years.

In one case in which the whole diaphysis became sequestrated from the tibia and was removed subperiosteally 4 years ago, the leg was amputated. The t bial fragments showed no evidence of uniting, and a secondary osteomyelitis of the adjoining fibula with acute exacerbations rendered removal of the limb the logical procedure.

Subperiosteal resection of the entire diaphysis or the removal of large sequestra involving the entire circumference of the shaft of long bones is to be avoided until sufficient involucrum has been formed to preserve the continuity of the bone. Of the 2 cases in this series in which the entire tibial diaphysis was removed, one had not regenerated after 4

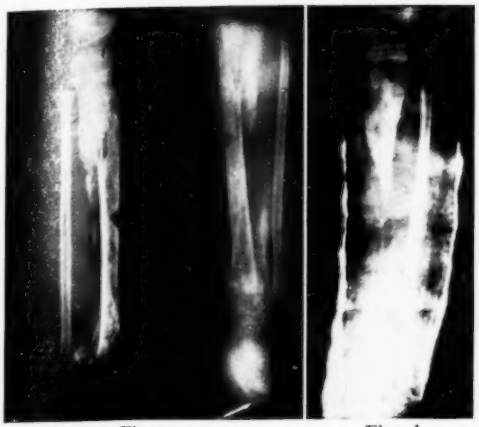

Fig. 1*a*. Fig. 1*b*.

Fig. 1*a*. The entire sequestrated tibial shaft *in situ* without complete involucrum formation. The entire sequestrated shaft was removed a week after this X-ray was taken.

Fig. 1*b*. The condition of the tibia 15 months later.

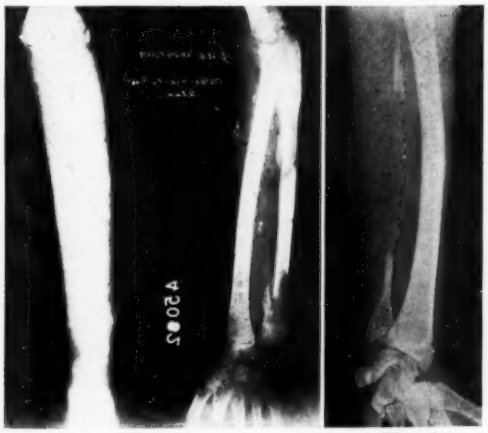

Fig. 2*a*. Fig. 2*b*.

Fig. 2*a*. Sequestration of the entire ulna shaft without complete involucrum formation. The entire sequestrated shaft was removed a week after this X-ray was taken.

Fig. 2*b*. The condition of the ulna 4 months later.

years and subsequently required amputation as previously stated. The other shows little tendency to regenerate after 15 months and will probably require a bone graft to restore the tibia. The 1 case in which the entire diaphysis of the ulna was removed shows slight regeneration after 4 years. The X-ray findings illustrate the above statement.

Figure 1*a* shows the entire sequestrated tibial shaft *in situ* without complete involucrum formation. Entire sequestrum was removed 3 days after this X-ray was taken.

Figure 1*b* shows the condition of the tibia 15 months later.

Figure 2*a* shows sequestration of the entire ulna shaft, without complete involucrum formation. The entire sequestrated shaft was removed a week after this X-ray was taken.

Figure 2*b* shows the condition of the ulna 4 years later.

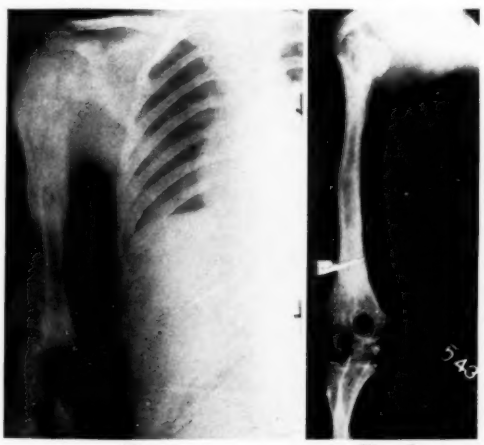

Fig. 3*a*. Fig. 3*b*.

Fig. 3*a*. Complete sequestration of the shaft of the humerus with sufficient involucrum formation.

Fig. 3*b*. The condition of the bone 3 years later.

Fig. 4*a*. Fig. 4*b*.

Fig. 4*a*. Complete sequestration of the shaft of another humerus.

Fig. 4*b*. The condition of this humerus 4 years later.

The above illustrations show the unfavorable results that obtain when sequestra are removed before sufficient involucrum has formed to preserve the contour of the bone.

Figure 3*a* shows complete sequestration of the shaft of the humerus with sufficient involucrum formation. The lower part of this sequestrum was removed a week after this X-ray was taken. The upper part was removed 3 months later. A pathological fracture occurred at the time of the removal of the upper part which subsequently united.

Figure 3*b* shows the condition of the bone 3 years later.

Figure 4*a* shows complete sequestration of the shaft of another humerus. The treatment was the same as that described for the case shown in Figure 3.

Figure 4*b* shows the condition of this humerus 4 years later.

Figures 3 and 4 show the favorable results obtained by waiting until the contour of the shaft has been preserved by sufficient involucrum before the removal of the sequestra.

The duration and prognosis are explained in Table VI.

CONCLUSION

The necessity of early diagnosis and proper surgical treatment cannot be too vigorously advocated. Too few of the cases in this series were recognized as osteomyelitis in the early stage when proper surgical intervention would have promised a short convalescence. The majority of these that did receive early care recovered within 4 months, on the average. Early surgical treatment is the only means of reducing the morbidity and mortality. If sufficient drainage is instituted in the early stages, destruction of the cortex is avoided and convalescence is short. If the time from onset to operation is measured in hours, the convalescence is measured in weeks; if measured in days the convalescence is measured in months or years.

We wish to express our thanks to Dr. Carl Burdick who is in charge of the Children's Surgical Service, Fourth Division, Bellevue Hospital, for the privilege of reporting these cases.

ELBOW FRACTURES AND DISLOCATIONS[1]

Treatment and Analysis of One Hundred Eighty-One Cases at Bellevue Hospital New York City

By IRWIN E. SIRIS, M.D., Brooklyn, New York

THIS paper consists of a study of 181 consecutive cases of fracture and dislocation in the region of the elbow joint treated on the Children's Surgical Service, Bellevue Hospital, between June, 1919, and August, 1924. They occurred in children under 13 years of age. The initial treatment was instituted in the wards and continued in the out patient department. It was to be expected that in obstinate and protracted cases the patient would be reluctant to return and would seek treatment elsewhere. With the co-operation of our social service department we were able to follow 172 cases (96 per cent).

It was found that the treatment after reduction was more important than the initial reposition and fixation. The clinical course demonstrated that accurate anatomical approximation of the fragments was not absolutely essential for complete restoration of function; that a disfigured elbow resulting from persistent displacement might have a most useful function while an anatomically restored elbow might be lacking in mobility unless judiciously treated.

Case 1. O. F., 5 years old, was admitted on August 9, 1922, after sustaining a transverse, supracondylar fracture with backward displacement of the distal fragment and with considerable swelling and ecchymosis. Patient was given an anæsthetic and by means of the fluoroscope, the fragments were approximated and the elbow placed in a position of hyperacute flexion and maintained with adhesive. Roentgenographic examination on the following day revealed slight posterior displacement of the lower fragment near the epiphysis. Active motion was instituted at the end of the first week. By the end of a month, extension and flexion were lacking 20 degrees. The child failed to return for 6 months at which time there was complete function with no disturbance in the outer contour of the elbow (Figs. 1 to 5).

Case 2. A. F., August 6, 1922, 9 years old, sustained a fracture of the external condyle which extended into the joint. By means of the fluoroscope the fragments were approximated and the elbow placed in a position of hyperacute flexion with an adhesive dressing. An X-ray on the succeeding day revealed slight rotation of the condyle with some contact with the shaft. The swelling gradually disappeared with the institution of active motion. Flexion was readily maintained. Extension was sluggish but considerable improvement followed the carrying of weights. Two months later the function was completely restored. There was a firm union but it was observed that there was a steady increase in the size of the external condyle with exuberant callus. The carrying angle remained unaltered. At present 2 years after the fracture there is no disability but there is a deformity from an enormously enlarged condyle (Fig. 6).

Case 3. F. J., 6 years old, admitted March 27, 1924, with marked anterior displacement of the lower end of the upper fragment; this being about 1 inch in front of the condylar portion. The lower end of the humerus was displaced posteriorly and outward. The ends of fragments were approximated with the aid of the fluoroscope, and partially immobilized with an adhesive dressing. Five weeks later the elbow could be extended to 160 degrees. The boy actively co-operated with exercises; no passive motion was allowed. On discharge from the hospital 3 months later, patient showed restoration of function and no deformity or loss in the carrying angle (Figs. 7 to 11).

CLASSIFICATION

In classifying fractures above the articular surface of the humerus no attempt was made to distinguish between an epiphyseal separation and fractures occurring above the epiphyseal line. Separation of the lower humeral epiphysis was very common in young children. It generally included the two condyles and the articular surfaces. It was extremely rare to observe in older children either a partial or a complete separation of the lower humeral epiphysis without a small fragment from the diaphysis remaining attached to it or the line of fracture running through the epiphysis into the articular surface. All the diacondylar, intercondylar, T, Y, and atypical fractures, were placed in the supracondylar group. Fractures of the epicondyles were considered

[1] Read before the Section of Surgery, New York Academy of Medicine, October 3, 1924.

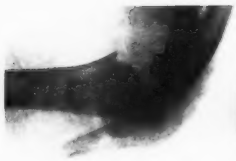

Fig. 1 (left). Case 1. O. F. Transverse supracondylar fracture with posterior displacement of lower fragment, August 10, 1922.

Fig. 2. Case 1. O. F. Persistent backward displacement of lower fragment with stripping of periosteum, September 14, 1922.

as epiphyseal separations. No distinction was made between fractures of the head of the radius and fractures of the neck, between the orbicular ligament and biceps tuberosity, as the treatment was the same. The only complicating fracture found with posterior dislocation of the radius and ulna was that of the capitellum and trochlear surface. There was no forward displacement of bones of the forearm.

FREQUENCY

There were 170 simple and 11 compound fractures. The supracondylar group was the most common type of injury, occurring 109 times (61 per cent) and found most frequently between the fifth and tenth years. Fractures

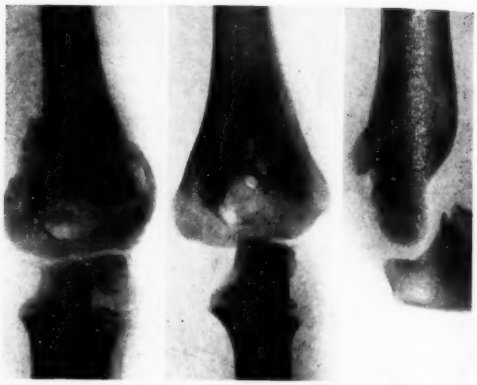

Fig. 3. Fig. 4. Fig. 5.

Fig. 3. Case 1. O. F. Anterior view, showing reparative process, September 14, 1922.

Figs. 4 and 5. Case 1. O. F. March 31, 1923. Union and restoration of bony contour.

of the internal condyle were encountered in 20 patients (11 per cent) and usually found in the ninth, tenth, and eleventh years. The 21 fractures (11.6 per cent) of the external condyle occurred chiefly in the fifth, seventh, and ninth years. The 3 fractures (1.6 per cent) of the olecranon and 5 fractures (2.7 per cent) of the head of the radius appeared after the eighth year. The 23 cases (12.7 per cent) of posterior dislocation of the radius and ulna were most frequently found between the ninth and eleventh years (Table I).

Fig. 6. Case 2. A. F. Increased size of external condyle 17 months after fracture. At present, 2 years after the fracture, there is no disability but the deformity as shown.

Fig. 7. Case 3. F. J. Supracondylar fracture, enormous swelling and characteristic deformity following posterior displacement of the lower end of the humerus.

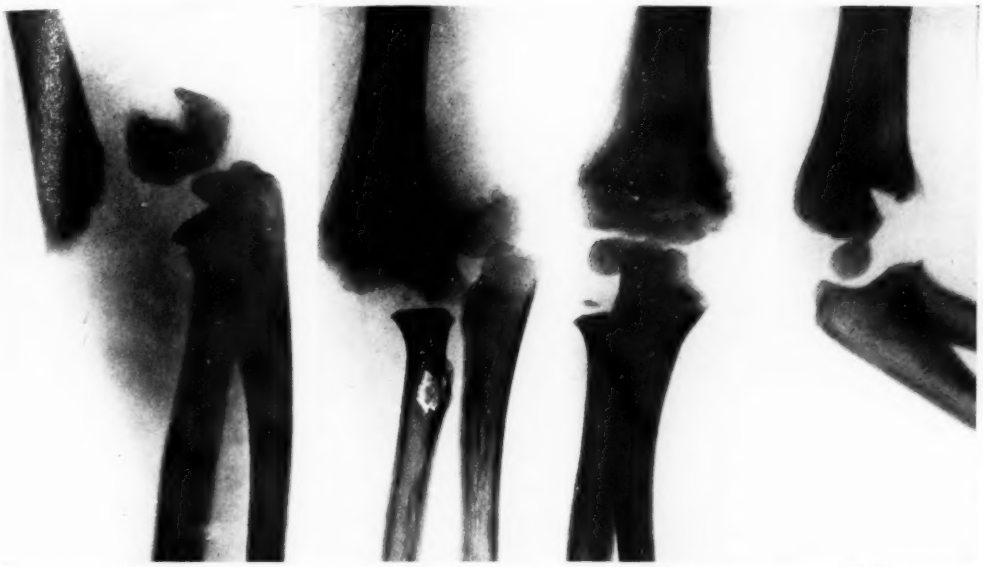

Fig. 8. Fig. 9. Fig. 10. Fig. 11.

Figs. 8 and 9. Case 3. F. J. Marked posterior and inward displacement of the lower humeral fragment and forearm, March 17, 1924.

Figs. 10 and 11. Case 3. F. J. August 22, 1924. Showing reparative process and beginning restoration of bony contour.

HISTORY

In the injuries producing supracondylar fractures there usually was a history of falling on the extended hand with the forearm partially outstretched, indirectly producing a fracture above the articular surface of the humerus; while those fractures which resulted from direct injuries were generally compounded and of a T or Y shaped variety. There was one case of forward displacement of the lower humeral fragment which resulted from direct violence.

The fractures of the epicondyles and condyles followed direct injury or twisting of the forearm. Six of the external and two of the internal condylar fractures extended into the joint. The posterior dislocations of the radius and ulna, with and without a fracture of the capitellum, were the result of indirect violence and usually occurred in older children. The fractures of the olecranon were all caused by direct violence, the patients falling on the bent elbow. From the case histories it was impossible to determine accurately the manner in which fractures of the upper end of the radius were produced. Scudder explains them by a fall forward upon the outstretched pronated hand with the elbow extended.

DIAGNOSIS

Every effort was made to arrive at an accurate diagnosis before the part was fluoroscoped. Extreme gentleness was exercised in all examinations and manipulations. The slightest disturbance in the relative position of the three bony prominences to one another and to the uninjured elbow was established, that is, the relation of the olecranon to the humeral condyles in the flexed and extended position. Then the mobility of the head of the radius to its shaft on supination and pronation was determined. The deformity (Fig. 7) accompanying posterior displacements of the lower humeral fragment in supracondylar fractures was very characteristic of this injury. General or localized swelling and pain not infrequently determined the seat of the lesion. Disturbance of the relative angle of the oblique articulating surface of the humerus with the ulna, as compared to the uninjured

TABLE I.—AGE INCIDENCE

Supracondylar fractures

Age	Cases
2	8
3	4
4	7
5	18
6	20
7	21
8	8
9	9
10	9
11	4
12	1
Total	109

Fracture of olecranon

Age	Cases
9	1
11	2
Total	3

Fracture of head of radius

Age	Cases
8	1
9	1
10	1
12	2
Total	5

Internal condyle

Age	Cases
6	1
7	1
9	4
10	8
11	4
12	2
Total	20

External condyle

Age	Cases
2	1
3	1
5	5
6	1
7	4
8	2
9	4
11	1
Total	21

Posterior dislocation of the radius and ulna

Age	Cases
2	1
3	1
7	2
8	3
9	6
10	4
11	5
12	1
Total	23

TABLE II.—DISPLACEMENTS

Supracondylar fractures

	Upper fragment	Lower fragment	Total
No displacement	34	34	
Posterior	2	47	
Anterior	47	2	
Internal	2	5	
External	5	2	
Posterior and interior	2	10	
Posterior and exterior	1	6	
Anterior and interior	6	1	
Anterior and exterior	10	2	
			109

Dislocation of the radius and ulna

	Total
Posterior	14
Posterior and external	8
Posterior and internal	1
	23

With fracture capitellum

Forward	5

Fractures of internal condyle

	Tota
No displacement	11
Internal and upward	9
	20

Fractures of external condyle

	Total
No displacement	15
Exterior and upward	6
	21

Fracture of head of radius

	Total
No displacement	3
Forward and outward	1
Internal and posterior	1
	5

Fracture of olecranon

	Total
No displacement	1
Upward	2
	3
Grand total	181

elbow, was ascertained so as to correct any deviation at the time of reduction, thus preventing cubitus varus or cubitus valgus.

To corroborate the clinical findings, the elbow was fluoroscoped and whenever possible an emergency X-ray was taken. An X-ray plate demonstrated the presence of 5 fractures of the condyles and in 7 cases a separation of the lower epiphysis without displacement, which were not detected under the fluoroscope. In 6 cases the X-ray failed to

demonstrate a fracture which clinically had every indication of a fracture being present. Jones called attention to this in 1910 stating that "it is impossible in quite a number of cases in young children, despite excellent pictures, to diagnose elbow fractures by means of the X-ray, and here our tactile education is invaluable. The reason for this is that the bones in early life are cartilaginous and therefore transparent."

TREATMENT

All fractures and dislocations were treated as *emergencies*, a member of the attending staff being called. The old accepted theory of waiting until the swelling had subsided is erroneous, detrimental and, fortunately, is no longer practiced. Swellings caused by lacerations of the soft tissues and extravasation of blood will cease and disappear the sooner the normal anatomical relations are restored. Permitting the position of the fragments to remain displaced results in organization of the blood in the soft parts, diminished elasticity of the muscles, and increased difficulty in reduction, particularly in supracondylar fractures. Continued pain and muscular spasm retard functional recovery and may be fraught with serious consequences. If the intricate formation of the articular surfaces of the joint with its fossæ and irregularities in contour is borne in mind, it will be seen that the slightest protrusion of bone into the joint combines with the organized hæmatoma in producing exuberant callus which may permanently impair its functions. This equally applies to posterior dislocations of the radius and ulna which may be complicated by a fracture of the coronoid, the capitellum or trochlear surface, often not detected until late, which, if not recognized and immediately reduced, may ultimately present a permanent limitation in mobility of the elbow.

The *procedure* in reduction consisted in the administration of an anæsthetic, on the fluoroscopic table, to all patients with displacement. No attempt at reduction was made until complete relaxation was obtained.

In supracondylar fractures, the forearm in supination was repeatedly flexed and extended so that the fragments were unlocked; traction was then made on the arm by an assistant, while the operator grasped the forearm with one hand and increased the deformity by hyperextension; with the thumb, forward pressure was made on the lower fragment and upper end of the forearm while counterpressure with the four fingers forced the lower end of the upper fragment backward. The forearm was then brought to a position of acute flexion; the position of the fragments were ascertained under the fluoroscope, and a fixation dressing applied. The position of acute flexion for all fractures in the region of the elbow joint excepting fractures of the olecranon process has long been advocated by Jones and Ashhurst. Jones states that this position gives "the most complete anatomical reposition of fragments and the best fixation. It favors the retention of the more important flexion function of the joint and it co-operates with gravity in the subsequent restoration of function."

In fractures of the *internal condyle*, the lateral mobility of the elbow with inward and upward displacement of the smaller fragment with its tendency to adduction of the forearm resulting in gunstock deformity, could often be obviated by pronating the forearm after pulling the fragment down and placing the elbow in acute flexion.

In fractures of the *external condyle*, the upward and outward displacement of the fragment frequently accompanied by lateral mobility had a tendency to abduct the forearm. The elbow was therefore fixed in a position of acute flexion with complete supination, the supinators being a great factor in limiting the pronounced increase in the carrying angle.

Fractures of the *head or neck of the radius* were maintained in acute flexion and supination for 3 to 4 weeks, as the presence of a rotated head, which cannot be perfectly restored may throw out callus into the joint which may also become attached to the ulna, limiting its mobility, under which condition it may be advisable to excise the radial head.

Fractures of the *olecranon process* were maintained in a position of extension with a posterior molded plaster splint for 3 to 4 weeks except for active flexion of about 30 to 40 degrees at the end of the second week,

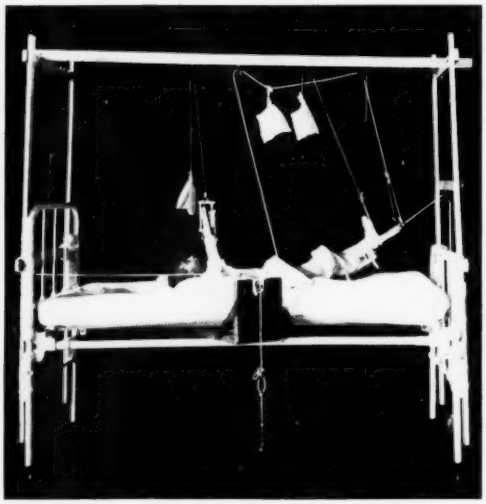

Fig. 12. Method of suspension of fractured elbow accompanied with enormous swelling and blisters where the administration of an anæsthetic and manipulation are contra-indicated.

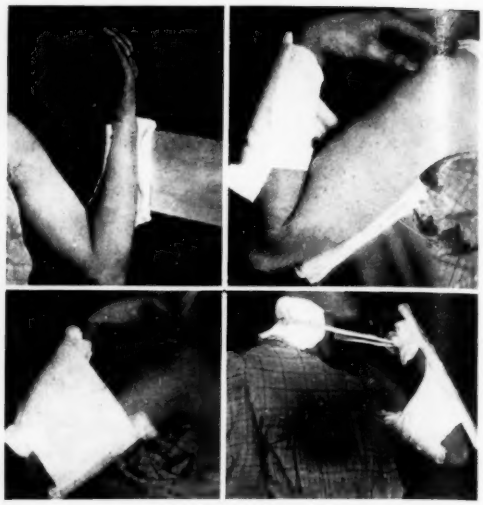

Fig. 13. Procedures in the application of adhesive. In the effort to restore early function and shorten convalescence, fractures about the elbow joint were partially immobilized.

when the cast was reapplied. In no case was the necessity for operative interference indicated.

METHODS OF FIXATION OF THE FRAGMENTS

The fractured elbows were treated in one of the five methods to be described: (1) pulley suspension in flexion; (2) suspension in a Thomas splint for compound fractures; (3) open operation; (4) molded plaster splints; (5) partial fixation with adhesive and early active motion.

1. Five children, who were admitted 24 to 72 hours after injury, with the fractures complicated by swelling and blisters, and with fragments that could not be successfully reduced under an anæsthetic, were treated by *suspension* from an overhanging frame with the arm in a position of flexion (Fig. 12). Countertraction was obtained with a pulley and weights and a sling placed over a cotton pad covering the lower third of the arm. The flexion was increased as the elbow began to resume its normal appearance. Occasionally this was sufficient to correct the displacement and active motion was instituted early. When the displacement persisted and there were indications that it would interfere with the mobility of the joint another attempt at reduction was undertaken and the elbow was placed in acute flexion with adhesive.

2. *Compound fractures.* As a result of experience with war wounds one was naturally inclined to adopt the war method in civil practice. Débridement and primary suture was attempted in 5 cases. In 3 cases primary union with an excellent functional recovery was obtained. In 2 cases the results were most discouraging. The stormy course attending débridement and primary suture gave cause for alarm. The few successful cases did not warrant the use of this procedure in children.

Assuming that every compound fracture was potentially infected, we obtained excellent results in 6 cases by cleansing the wound, reducing the fracture, and instituting the Carrel-Dakin method of sterilization. The arm was suspended in a flexed Thomas splint with traction by adhesive from the supinated forearm. If the condition of the wound permitted a secondary suture, it was performed; or the wound was allowed to heal by granulation.

As soon as it was determined that the infection was under control and some degree of

union had taken place, active motion was begun. When it was suspected that ankylosis would follow the septic process, the elbow was put in a position which later would be most serviceable, that is, 15 degrees beyond a right angle.

3. *Open operation for simple fractures.* Early reduction under the fluoroscope with an anæsthetic usually results in apposition of the fragments. If this is not possible, open operation need not be undertaken, as it has been repeatedly demonstrated that accurate anatomical approximation of fragments, particularly in supracondylar fractures, is not absolutely essential for complete restoration of function. In fractures of the condyles, in which the rotation of the fragments could not be overcome by a closed reduction, the question of securing the condyles to the shaft by an open operation was not considered because of the satisfactory functional results obtained with early active motion, even though there was marked displacement. There was marked displacement of 9 internal and 6 external condyles, all of which united and presented an exuberant amount of callus which persisted for a long time but gradually diminished.

4. *Molded plaster splints.* The fractures about the elbow occurring during the first 18 months of this series were treated by the routine anterior and posterior molded plaster splints in a position of acute flexion. Three of these patients developed Volkmann's ischæmic paralysis. The elbow was examined daily until the patient was discharged from the hospital, and every other day thereafter in the out patient department. Beginning with the third week, active and passive motion was begun and the splints were reapplied in acute flexion. At the beginning of the fourth week the splints were applied in the position of a right angle. By the fifth week the casts were usually replaced by a sling and baking and massage were resorted to. In several cases, these procedures resulted in appreciable improvement in mobility of the elbow, but in many children the convalescence was unduly prolonged, because of the muscular rigidity, exuberant callus, and myositis ossificans that followed too active massage and passive motion.

5. *Partial fixation with adhesive and early active motion.* In the effort to restore early function and shorten convalescence, early active motion, within a limited range was instituted by partially immobilizing the elbow with an adhesive dressing (Fig. 13).

The adhesive dressing is applied as follows: A wide strip of adhesive, four pieces of gauze, and a padded board splint are used. The strip of adhesive varies from 3 to 4 inches in width, and is of sufficient length to encircle the arm and forearm. The strip of adhesive is applied on the palmar surface of the forearm at the inner border of the radius beginning below the styloid process extending out and around over the back of the forearm covering the first piece of gauze; continuing around the arm over another thick layer of gauze, close to the lower edge of the axilla and overlapping the adhesive over the back of the forearm. The splint, two-thirds the width of the forearm, extending from the metacarpophalangeal articulations to the elbow, is applied to the back of the forearm and to the hand with adhesive. The third piece of gauze encircles the wrist around which a sling is tied with a surgical knot to prevent constriction. The sling is secured around the neck over the fourth piece of gauze, bringing the knot to the inner side of the wrist to encourage supination. By applying adhesive on the inside of the radius, constriction of the forearm is avoided and supination is more readily maintained. Only two-thirds of the back of the arm and forearm are covered with gauze to allow the adhesive to adhere to some of the skin; the gauze extending one-half inch above and below the adhesive. The splint prevents sagging of the hand, a condition not uncommonly encountered in treatment with bandaged or adhesive flexion.

The dressing was examined daily. When the subsidence of the swelling resulted in sagging of the adhesive and permitted an increase in the range of motion, a second strip of adhesive was placed about the dressing with the elbow in more acute flexion. Thereafter active motion was allowed within the limits of the dressing. There need be no apprehension of dislodging the fragments by early limited motion as the powerful muscles about the elbow splint the fragments. In no case was the position of the fragments disturbed by the institution of this procedure before complete union had taken place. If the apposition of the fragments was perfect the dressing was not disturbed for 2 weeks, while in children, in whom the displacement had not been entirely corrected, the acute flexion was maintained for 3 weeks. The adhesive was then cut down on both sides and the range of active motion increased as much as the patient would com-

Fig. 14. Fig. 16. Fig. 15.

Fig. 14. Case 4. I. F. March 18, 1920, comminuted Y supracondylar fracture extending through the olecranon fossa for 1 inch and from this point obliquely inward and outward.

Fig. 15. Case 4. I. F. May 25, 1920. Lateral view of reparative process.

Fig. 16. Case 4. I. F. May 6, 1923. Anterior view showing completely reconstructed humerus.

fortably permit. A similar dressing was then applied with the elbow in 45 degree extension for another week; this allowed a greater range of activity. The following week the adhesive was applied with the elbow at a right angle or the elbow was permitted to be carried in a sling. Active flexion and extension were repeated at home every hour. Beginning with the fourth week in accurately reduced fractures and in the fifth week with persistently displaced fragments, the extension was permitted beyond a right angle and the patients were allowed to carry weights. The co-operation of the patients was shown by their willingness to demonstrate the pliability of their elbow by actively extending and flexing their elbow within full possible limits. If the patient was unable to obtain the initial degree of flexion, while the extension was increasing, the elbow was replaced in acute flexion for another week; this was an indication that extension was progressing too rapidly at the expense of flexion.

It is very apparent that forcing motion under an anæsthetic in protracted and obstinate elbows is not only useless but harmful. Under the anæsthetic, the fibrous adhesions are broken up and the range of motion increased at the expense of laceration of the soft parts, with the result, that on the succeeding days the limitation of motion has become more pronounced. The results from adhesive fixation and early active motion have been so uniformly satisfactory that the number of protracted cases have been in the comparatively few cases of children who have failed to return regularly. These cases have responded satisfactorily to baking and very gentle caressing of the soft parts, augmented with active exercises, such as carrying weights or work in the Department of Occupational Therapy. It was found that these procedures prevented muscular contractures, exuberant callus, myositis ossificans and Volkmann's ischæmic paralysis, and eliminated the pain which accompanies delayed and passive motion with too active massage.

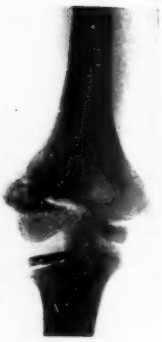

Fig. 17. Fig. 18. Fig. 19.

Fig. 17. Case 5. F. DeM. June 28, 1922, fracture through lower articulating surface of humerus.

Figs. 18 and 19. Case 5. F. DeM. Showing reparative process in the comminuted fracture of capitellum, trochlear and external condyle.

COMPLICATIONS

The complications following fractures about the elbow were of a serious nature. Fortunately when recognized early they were cured and practically all could have been prevented. In order of frequency the complications encountered were the following:

(1) Rigidity of the elbow from muscular spasm; (2) exuberant callus; (3) musculo-

Fig. 20.

Fig. 21.

Fig. 20. Case 6. G. H. Myositis ossificans traumatica, 4 months after a fracture of the internal condyle had been sustained as the result of too active massage.

Fig. 21. Case 6. G. H. Three years later showing slight evidence of periosteal thickening.

spiral and ulnar nerve compression; (4) myositis ossificans, traumatic; (5) Volkmann's ischæmic paralysis.

1. *Rigidity of the elbow* due to muscular spasm occurred in 20 of our early cases from too active massage, passive motion, or motion under an anæsthetic. These procedures usually at first produced temporary improvement in the mobility of the elbow only to be followed by induration, swelling, exuberant callus and pain, with frequently a loss in the range of motion. These procedures are mentioned only to be vigorously condemned. In cases of muscular spasm, complete rest for 1 to 2 weeks with gradually increasing active exercises resulted in satisfactory improvement of function.

2. *Exuberant callus.* The clinical records showed 30 cases of exuberant callus. In no other joint is the presence of exuberant callus more to be deplored than in the elbow. Displacement of fragments in intra-articular fractures demand accurate anatomical reposition and prolonged immobilization. The greater the displacement the greater the outpouring of callus and the greater the limitation of mobility. Too great activity in massage and passive motion will stimulate osteogenesis which will result in muscular spasm, exuberant callus, and myositis ossificans. There was not a single case of non-union as children have demonstrated excellent reparative powers.

Case 4. I. F., a girl 8 years old, was admitted March 17, 1920, with a comminuted Y supracondylar fracture extending through the olecranon fossa for a distance of 1 inch, and from this point obliquely inward and outward. The condylar fragments were separated about ½ inch, the lower end of the upper fragment extending between these two. The elbow was suspended with adhesive in acute flexion from an overhanging Balkan frame with countertraction on the lower end of the upper fragment. The swelling gradually disappeared and the fragments assumed a satisfactory position. Active motion was instituted at the beginning of the third week. The patient was discharged from the hospital 37 days after receiving the injury, extension lacking 30 degrees and flexion minus 45 degrees. One year later there was a complete functional recovery, except for a diminution in the carrying angle of 5 to 10 degrees (Figs. 14 to 16).

Fig. 22. Case 6. G. H. Showing limitation in extension and exaggerated carrying angle.

Case 5. F. DeM., 7 years old, fell June 28, 1922, sustaining a transverse fracture through the lower end of the diaphysis of the right humerus separating a small fragment, about a centimeter thick from the shaft. There was some forward displacement of the capitellum with marked infiltration of the soft tissue. Under an anæsthetic the fragments were opposed and the elbow maintained in acute flexion with adhesive. Slowly graded active motion was begun at

Fig. 23. Hyperextension elastic hinge splint.

Fig. 24. Fig. 25. Fig. 26. Fig. 27. Fig. 28.

Fig. 24. Case 8. S. R. Persistent posterior displacement of lower humeral fragment after 3 unsuccessful attempts at reduction.

Figs. 25 and 26. Case 8. S. R. Reparative process involving stripped periosteum, 3 months later.

Figs. 27 and 28. Case 8. S. R. Two and a half years later, bony contour practically normal.

the beginning of the second week. Flexion was actively maintained; the extension was very slow, at the end of 6 months it was 140 degrees and had a good carrying angle. The comminution of this fracture was rather marked and gave cause for concern as to mobility. Although extension was lacking 40 degrees in January, 1922, the usefulness of the elbow was very apparent. The boy has failed to return (Figs. 17 to 19).

3. *Musculospiral, and ulnar nerve compression.* There were 9 fractures complicated by compression of nerves about the elbow (7 of the musculospiral and 2 of the ulnar nerves). It is important to determine the presence of paralysis before reduction is attempted. Not infrequently paralysis is discovered during the first week and may be due to stretching of the nerve or pressure by a fragment. When it develops later it is usually due to compression by exuberant callus. These cases of paralysis were all accompanied by loss of sensation. In musculospiral paralysis, the posterior interosseous nerve was most commonly injured beneath the supinator brevis and resulted in the inability to extend the wrist, fingers, or thumb. This paralysis was never permanent. All the cases responded to treatment with an elastic palmar hinge splint augmented by gentle massage and electrical stimulation. The two cases of ulnar paralysis complicating supracondylar fractures responded to treatment; 1 within 3 months and the other, which had a marked wasting of the interossei showed evidence of return in sensation in 3 months and regeneration of the muscles in 6 months (see Case 9, J. O'C.).

4. *Traumatic myositis ossificans*, in 7 of our early protracted cases, followed too great activity in massage and passive motion. Our physiotherapeutic department most willingly co-operated, and in their zeal to improve the range of motion, resorted to kneading massage and passive motion. Within 3 to 4 weeks there was considerable induration and a bony hardness over the brachialis anticus. This form of irritation, traumatizing the soft tissues, resulted in laceration of the muscular fibers with hæmorrhage and a plastic inflammation followed by ossification of the fibrous tissue from the injured periosteum outward. This condition occurred even though there had been no displacement of the fragments. The most pronounced case followed a fractured internal condyle which had no displacement. The bony growth assumed tremendous proportions, its base was 2 by 1½ inches and projected in the form of a pyramid for 1 inch from the cancellous tissue. By discontinuing all treatment the tumefactions finally disappeared.

CASE 6. G. H. was admitted to Bellevue Hospital August 9, 1920. Fluoroscopic examination did not reveal the presence of fracture. There was a fluctuat-

Fig. 29.

Fig. 31, *a*.

Fig. 31, *b*.

Fig. 29. Case 9. J. O'C. Marked forward and outward displacement of the lower end of the upper humeral fragment.

Fig. 31, *a* and *b*. Case 9. J. O'C. Comparison of the right and left lower ends of the humeri 3 years later.

ing mass on the inner aspect of the elbow joint. The elbow was placed in acute flexion. An X-ray taken with the joint in plaster molded splints did not reveal the presence of a fracture. However, considerable tenderness and ecchymosis was still evident in the region of the internal condyle. The boy returned to the clinic where the plaster splints were removed on August 31, and an X-ray revealed a fracture of the internal condyle. There was considerable limitation in supination, pronation, and particularly in extension. The child was referred for baking and massage. It was soon observed that there was considerable induration although there was a decided improvement in extension. The extension became less marked and the flexion remained stationary lacking 40 degrees. X-ray examination revealed pyramidal bony tumor, i.e., a condition of myositis ossificans. The massage and passive motion were discontinued December 11, 1920. The progress was very slow. By the middle of January the extension had improved to 165 degrees. The internal condyle was very prominent but there was no limitation in supination and pronation. Three and a half years later there was no evidence of myositis ossificans. The extension was limited about 10 degrees and the carrying angle exaggerated 10 degrees. No impairment in supination and pronation (Figs. 20 to 22).

5. *Volkmann's ischæmic paralysis.* Unfortunately, this serious complication occurred in 4 children. Three followed the application of molded splints in too extreme flexion and one resulted from a pad placed in the anticubical space. In 2 children this condition was

Fig. 30.

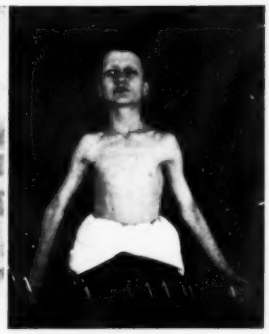

Fig. 32.

Fig. 30. Case 9. J. O'C. Fragments incompletely approximated and immobilized in molded splints.

Fig. 32. Case 9. J. O'C. Note loss of carrying angle and complete extension (flexion not impaired).

detected within 24 hours, and in 2 others remained unrecognized for 3 days. In these cases, constriction, too extreme flexion or a pad in the fold of the elbow produced a compression paralysis of the muscles and nerves of the forearm. Examination revealed a limpid hand. When the wrist was extended the metacarpophalangeal joints became extended and the interphalangeal joints flexed. When the wrist was flexed the fingers became extended and the hand invariably assumed a pronated position with the forearm semiflexed. Practically no active motion was possible; passive motion produced pain. The sensation was not entirely lost in any of the cases but there was partial to complete temporary loss of motor function in all cases. The paralysis of the musculospiral nerve was not as pronounced as was that of the median and ulnar. The paralysis of the nerves was a minor factor compared to the cicatricial contracture of the muscle fibers which inhibited motility. Stewart and Evans, in exploring for the median and ulnar nerves in a case of Volkmann's ischæmic paralysis, found them adherent on their deeper surfaces and depressed below the level of the rest of their course over the site of a fracture. The nerves were hardened due to overgrowth of fibrous tissue outside and between the nerve elements. In our cases no operative measures were undertaken. They were treated by hyperextension with an elastic hinge splint attached to the

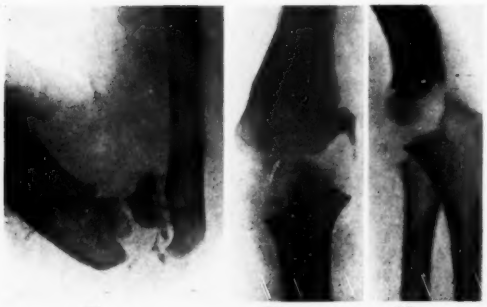

Fig. 33. Fig. 34. Fig. 35.

Fig. 33. Case 11. D. M. Compound irregular, transverse supracondylar fracture with marked anterior displacement of the lower humeral fragment.
Fig. 34. Case 11. D. M. Anterior view 7 months later.
Fig. 35. Case 11. D. M. Lateral view 13 months later.

palmar surface of the forearm as illustrated (Fig. 23). The splint was worn 2 or 3 days and reapplied 2 days later; this procedure was repeated as often as necessary. Within the past 2 months a molded plaster elastic hinge splint on the dorsum of the hand has been more effective. Baking, massage, and electrical treatment failed to give the response that followed active and passive motion with a hinge splint. It was apparent that too great activity in the former direction resulted in induration and stiffness and further decreased the elasticity of the muscles.

CASE 7. R. Cl., 8 years old, sustained a fracture of the left external condyle on May 19, 1923. The elbow was immobilized in acute flexion with molded plaster splints. The mother signed a release the same afternoon. The child did not return until June 2; when it was observed that he had a Volkmann's ischæmic paralysis. He was readmitted to the ward and a hinge splint was applied with the wrist and fingers in extension. He was discharged to the clinic with slight improvement. Our social worker brought him to us after a 2 months' absence. During this period he had been under treatment in the Ruptured and Crippled Hospital where Dr. Coley, Jr., had applied a metal splint in extension with decidedly beneficial results.

END-RESULTS IN SUPRACONDYLAR FRACTURES

There were 101 simple and 8 compound supracondylar fractures (61 per cent). Nine of the simple fractures could not be followed; 7 of these had been treated with adhesive and were making satisfactory progress; the other 2 had been treated with molded splints, the

Fig. 36. Fig. 37. Fig. 38.

Fig. 36. Case 16. S. P. Lower end of upper humeral fragment which had been stripped of its muscular attachments and laid on the forearm, replaced and immobilized in plaster splints.
Figs. 37 and 38. Case 16. S. P., 4 years later, bony contour restored.

fragments in both cases were in good apposition and the results promised to be good, except for the weakness in the extensors of the wrist in a case which appeared to be making satisfactory progress.

Of the 92 remaining cases of simple fractures which were followed, 29 were treated with molded plaster splints. There were 26 of these children who were discharged with excellent functional results; 11 of these left the hospital with perfect apposition of the fragments and the remainder with varied displacements as indicated in Table II. Of these 26 patients with complete restoration of function, 4 had had musculospiral and 2 ulnar nerve paralysis. In 9 of these fractured elbows there was a diminution in the carrying angle. Three of the 29 patients in this series did not respond to treatment readily and have been under observation from 3 to 4 years.

CASE 8. S. R., 11 years old, was admitted 24 hours after injury with an enormous swelling of the elbow and a marked posterior displacement of the lower humeral fragment. Three attempts on successive days to reduce the fragments were unsatisfactory because of the extensive extravasation and blistering of the elbow. Molded splints were applied for 2 weeks. Active and passive motion was gradually increased, augumented with baking and gentle

Fig. 39.

Fig. 39. Case 18. S. Cr. Compound supracondylar fracture unreduced complicated by a fracture of the radius and ulna. Carrel-Dakin treatment after unsuccessful débridement and primary suture.

Fig. 40.

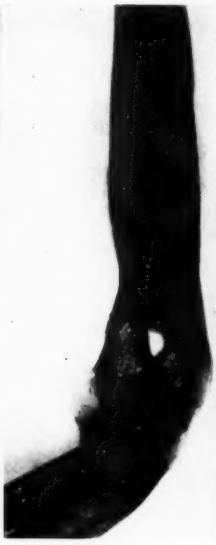

Fig. 41.

Figs. 40 and 41. Case 18. S. Cr., 2 years later, bony ankylosis.

Fig. 42.

Fig. 42. Case 18. S. Cr., 1 year after admission. This was not a suitable case for primary suture.

massage. The progress was slow. After 4 years the fragments have assumed a normal outline and there is a flexion deformity of 60 degrees, and an extension deformity of 160 degrees. Supination, pronation, and the carrying angle were normal. This was the most obstinate of all cases with persistent displacement. Similar cases have since been treated by suspension with adhesive and better apposition of the fragments and earlier and more complete restoration of function (Figs. 24 to 28).

CASE 9. J. O'C., a boy, 7 years old, admitted July 9, 1920, after attempting to climb from a window, fell on his outstretched hand. Fluoroscopic examination confirmed the presence of a low supracondylar fracture ½ inch above the articular surface with

Fig. 43.

Fig. 45.

Fig. 46.

Fig. 43. Case 21. H. Z., six weeks after admission, detached external condyle removed, internal dislocation of radius and ulna persisting.

Figs. 45 and 46. Case 21. H. Z., 1 year later; bony ankylosis.

Fig. 44. Case 21. H. Z., outer appearance, 2 months after admission.

Fig. 47. Case 21. H. Z. Two and a half years after compound fracture of the external condyle with posterior dislocation of the radius and ulna.

Fig. 48. Case 22. H. R. Fracture of the internal condyle and fracture of the head of the radius, 3½ years later; cross union limiting supination and pronation.

marked posterior and inward displacement of the elbow. Under an anæsthetic the fragments were approximated and the elbow maintained in a position of hyperacute flexion with molded plaster. The enormous swelling about the elbow gradually disappeared. Active motion was instituted on the ninth day. At the end of the third week the child was referred for baking and massage which resulted in a temporary improvement in mobility for 6 weeks. It was then observed that there was a tendency to dropping of the wrist and an exuberant amount of callus at the site of the fracture. Baking and massage were discontinued and a hinge splint was applied with traction of the fingers in a position of extension with rubber elastic. Four weeks later the wrist drop was still present and there was no change in the mobility of the elbow. An anæsthetic was administered with the elbow in a position of 120 degrees flexion and an extension of 150 degrees. The mobility was increased 20 degrees but the hand and forearm became helpless for about a week and the mobility less marked. This demonstrates the impractibility of the procedure. The extension splint was reapplied to the wrist and in 6 weeks the extension of the wrist completely improved. It is to be assumed that the musculospiral nerve had become imbedded in callus resulting in a temporary paralysis, which disappeared with the absorption of the callus. At present there is a marked gunstock deformity with complete flexion, extension, supination and pronation, but no evidence of musculospiral paralysis (Figs. 29 to 32).

Fig. 49.

Fig. 50.

Fig. 49 (left). Case 23. M. S. Fracture of the articular surface of the head of the radius; forward and outward rotation of smaller fragments.

Fig. 50. Case 23. M. S., 1 year later, no limitation in function.

Case 10. J. M., 9 years old, was admitted June 16, 1921, with a supracondylar fracture of the left humerus. The fragments were partially approximated and then immobilized in molded plaster splints. Three days later Volkmann's ischæmic paralysis was detected. The splints were replaced by wet dressings. With the subsidence of the swelling and signs of union a hinge splint was applied with the fingers and wrist in extension. This was augmented with gentle massage and diathermy. There has been an appreciable improvement in the paralysis.

Sixty-three of the 91 simple supracondylar fractures were partially immobilized with adhesive. In 5 of these the fractured part had been suspended in flexion from an overhanging frame because of the extensive extravasation in the soft parts. Twenty-one children were discharged from the hospital

with the fragments in perfect apposition and 42 with various displacements as indicated in Table II. In 2 cases, a musculospiral paralysis developed and was cured within 2 months. In this series, there were no cases complicated by Volkmann's ischæmic paralysis or myositis ossificans, and only 8 children showed some diminution in the carrying angle. The 63 children had complete restoration of function within 5 weeks to 3 months.

In the 17 simple supracondylar fractures in which a loss in the carrying angle later developed the fragments had not been accurately reduced; this was particularly true in cases of separation of the lower humeral epiphysis.

There were 8 cases of *compound* supracondylar fracture, all of which were followed up; 7 patients were discharged with perfect function; 1 developed mysositis ossificans, and 2 had a diminution of the carrying angle. The eighth case resulted in a bony ankylosis of the elbow.

CASE 11. D. M., 4 years old, was admitted June 10, 1922, with a small wound in the antecubical fossa with an irregular transverse supracondylar fracture, with marked, *anterior* displacement of the smaller fragment. Débridement was done, the fragments were reduced, the wound was packed with acriflavine and a posterior molded plaster splint was applied in acute flexion. On the fifth day, secondary suture was performed and the wound healed without infection. On discharge of patient from the hospital active motion with baking and gentle massage was encouraged. At the end of a year the child had a complete functional recovery except for very slight outward deviation in the carrying angle (Figs. 33 to 35).

CASE 12. J. R., 3 years old, was admitted May 16, 1920, with a compound supracondylar fracture. The wound was treated by the Carrel-Dakin method. There was no displacement of the fragments. The elbow was suspended in a Thomas splint. A Wolff skin flap operation was performed, to close a large granulating wound over the back of the elbow. The final result was excellent. No disability or deformity resulted.

CASE 13. T. S., 6 years old, was admitted March 21, 1921, with a compound supracondylar fracture with posterior displacement of lower fragment. Débridement was done and Carrel-Dakin treatment instituted. A Thomas splint was used. The wound healed by granulation. In 5 months the function was complete. No disability resulted except diminution in carrying angle.

CASE 14. T. E., 6 years old, was admitted September 1, 1920, with a compound supracondylar fracture with posterior displacement of the lower fragment. Débridement was done. The Carrel-Dakin method of sterilization was employed. The arm was suspended in a Thomas splint. The wound healed by granulation. There was excellent functional result in 6 weeks.

COMPOUND FRACTURES—PRIMARY SUTURE

CASE 15. D. H., 5 years of age, was admitted August 19, 1920, with a small wound ½ inch to the inner side of the crease of the elbow. There was profuse bleeding and considerable swelling deformity. Fluoroscopic examination revealed the presence of a transverse fracture above the epiphysis with marked posterior displacement of the lower fragment. Under an ether anæsthetic the fragments were approximated. An anterior and posterior molded splint was applied. A subsequent X-ray examination showed the fragments to be in good apposition. The wound healed by primary union. Voluntary motion was begun on the fifth day. Every other day voluntary motion was repeated and the splints reapplied. Within a month there was flexion of 130 degrees and extension of 150 degrees. The child was referred for baking and massage. Four weeks later there was considerable thickening at the elbow, suggesting probable bony muscular changes confirmed by the X-ray. This undoubtedly was the result of kneading massage; the baking and massage were discontinued. Within two months the thickening and swelling had disappeared. One year later there was a complete functional recovery with no deformity. The carrying angle of both arms was very small; the affected side appeared to be diminished 5 to 10 degrees.

CASE 16. S. P., 10 years old, was admitted December 10, 1919, with a compound supracondylar fracture. The lower 2½ inches of the upper fragment was projecting through the skin and was resting on the forearm with the muscles completely detached. A débridement was performed, the upper fragment replaced and with difficulty the lower fragment which had rotated backward was brought forward, and the ends of the fragments approximated. The wound was closed and molded splints applied. There was no reaction. The wound healed except for a stitch abscess. Active motion was instituted, augmented with baking and massage. One year later there was a complete functional recovery except for a slight deviation in the carrying angle (Figs. 36 to 38).

CASE 17. W. F., 7 years old, was admitted August 13, 1919, with a compound comminuted supracondylar fracture. Débridement and apposition of fragments with Kangaroo tendon were done. The elbow was maintained in extreme flexion with molded splints. The patient was discharged October 21, 1919, with extension deformity of 150 degrees and complete flexion. At present there is no disability or deformity.

CASE 18. S. C., 7 years old, was admitted July 7, 1921, with a compound supracondylar fracture associated with a fracture of the radius and ulna and

possible fracture of the skull. Under an anæsthetic, open operation and débridement were done, the fragments were approximated, and the wound closed. The elbow was placed in acute flexion with molded splints. The condition was very poor, the wound sloughed, and there was considerable undermining of the skin which was excised and the pus evacuated. The wound was treated by the Carrel-Dakin method. There was necrosis of the radius and ulna at the site of the fracture with separation which persisted for 4 months. When discharged from hospital patient had an ankylosis of the elbow in a position of 145 degrees extension with flexion of the fingers.

NOTE.—Condition of the patient and the extensive wound of the elbow did not make this a suitable case for primary suture.

END-RESULTS IN FRACTURES OF INTERNAL CONDYLE AND EPICONDYLE

There were 20 simple fractures of the condyles and epicondyles, all of which were followed up. In 7 children roentgenograms revealed fractures which could not be detected with the fluoroscope. There were 2 intra-articular fractures of the internal condyle which did not impair the mobility of the joint. Eleven cases were discharged without displacement; in 9 the smaller fragment was displaced internally and upward. Six of these elbows were immobilized in acute flexion with molded plaster splints and 14 with adhesive. In 16 children there was no impairment in function after a period of 5 weeks to 3 months though a slight prominence of the internal condyle was present in 3 of the cases and a diminution in carrying angle in 7. In none was there any indication for operative interference.

In 4 of the elbow cases myositis ossificans resulted from too active massage and passive motion. Two of these children showed no evidence of this condition at the end of a year. In two a very marked bony muscular change ensued which persisted for almost 3 years; 1 has a limitation in extension of 60 degrees and the other of 30 degrees, although all of the myositis ossificans had disappeared. (See Case 6, G. H.)

CASE 19. B. M., 7 years old, was admitted September 24, 1920, with marked swelling ecchymosis over the internal condyle. Fluoroscopic and X-ray examination revealed inward and forward rotation of the internal condyle. The forearm was placed in acute flexion and maintained in position with adhesive. The child was hysterical. It was difficult to obtain her co-operation so no voluntary motion was obtained. She was sent for baking and massage. Her progress was very slow and as a result of the massage there was considerable induration about the elbow. Massage was discontinued. It was only after 6 months that any co-operation was obtained. The X-ray examination then showed a fracture of the internal condyle with several minute fragments, the olecranon process divided into several fragments, and some evidence of a myositis ossificans. At the end of 3 years the extension lacked 30 degrees but there was a good carrying angle; flexion, supination, and pronation were complete. This case also illustrates that fracturing of minute fragments of bone may occur from too active massage and passive motion.

END-RESULTS IN FRACTURE OF EXTERNAL CONDYLE AND EPICONDYLE

Twenty of the 21 fractures of the external condyle and epicondyle were followed up. Of these, 20 were simple and 1 was compounded. Fifteen were discharged from the hospital with the fragments in perfect anatomical apposition; in the other 6, the fragments were rotated upward and outward. The X-ray revealed the presence of fractures in 4 elbows which were not detected by the fluoroscope. There were 4 intra-articular fractures, none of which interfered with restoration of the mobility of the joint. Of the 20 children followed up, 13 had been treated with adhesive, all but 1 having been discharged with perfect function within 6 months, as were 5 of the 6 cases treated with plaster splints. In 4 cases there was an increase in the carrying angle. In no case was it necessary to secure the condyle by open operation.

CASE 20. A. R., 7 years old, sustained an irregular oblique comminuted fracture of the external condyle which was treated with adhesive. He failed to return regularly to the clinic. At the end of a year his only limitation was in extension for 30 degrees. (See also Case 7.)

The *compound* fracture, Case H. Z., was associated with a posterior dislocation of the radius and ulna. Débridement, reduction and primary suture, with immobilization in plaster were followed by a stormy course and an ankylosis of the elbow joint.

CASE 21. H. Z., 9 years old, was admitted October 26, 1920, with a compound fracture of the external condyle accompanied by a posterior dislocation of radius and ulna, and laceration of the triceps tendon; the medial nerve was exposed. Under an anæsthetic

the wound was cleaned, the dislocation reduced, and the detached external condyle was removed; the triceps was sutured and the wound closed. The elbow was flexed in a Thomas splint. The same night the temperature rose to 106 degrees; she appeared very toxic. The wound was re-opened, Carrel tubes were inserted and Dakin solution was used every 2 hours. The temperature remained elevated for several days; as the discharge became more profuse the temperature came down. The posterior displacement of the radius and ulna recurred and persisted after an effort to reduce it under the fluoroscope was unsuccessful. One month later there was paralysis of the musculospiral nerve. Three months later there was no evidence of paralysis. The 30 to 40 degrees motion diminished in spite of active motion, which was very ineffective. There is now an extension of 130 degrees with complete ankylosis, but no paralysis of the hand (Figs. 43 to 47).

END-RESULTS IN FRACTURE OF THE HEAD AND NECK OF THE RADIUS

Of the 5 cases of simple fractures of the head and neck of the radius, 2 were treated with plaster and 3 with adhesive in complete flexion and supination. When the patient was discharged from the hospital the fragments were in anatomical apposition in 3 cases, 1 of which was associated with a separation of the external condyle; none of these presented any disability after the third month. There were 2 cases with a displacement which persisted; 1 of these (M. S.) had a forward and outward displacement which resulted in excellent function. The other (H. R.), had a posterior and internal displacement, the line of fracture running between the orbicular ligament and bicipital tuberosity; in the final result there was a fusion between the smaller fragment and ulna which partially limited supination and pronation.

CASE 22. H. R., 11 years old, was admitted October 23, 1920. There was considerable swelling in the region of the internal condyle and the upper end of the radius. The fluoroscopic examination did not reveal the presence of a fracture. A wet dressing was applied. X-ray examination revealed a transverse comminuted fracture of the radial head with inward and backward displacement of the upper fragment. The epiphyseal line was normal. Attempt to replace this fragment was unsuccessful by the closed method. It was decided that as long as the ends were slightly approximated and did not extend into the joint, no open operation would be undertaken. The elbow was placed in a sling with a wet dressing for 3 days and then in a posterior molded splint at right angles and supination. Three weeks later massage and baking was begun. In 1 month extension had improved to 135 degrees and myositis ossificans was present. Baking and massage were discontinued. Three and a half years later the forearm was in a position of midsupination and pronation, complete extension, and flexion lacking 30 degrees, but there was no evidence of myositis ossificans. The X-ray examination showed the callus uniting the head and neck of the radius to the ulna (Fig. 48).

CASE 23. M. S., 9 years old, was admitted May 20, 1922, with the articular surface of the head of the radius directed forward and outward. The ends of the fragments were approximated, and the elbow was immobilized with adhesive in acute flexion in a position of supination. Active motion was begun in the second week within a limited range of 60 degrees. At the end of the seventh month the X-ray demonstrated persistent rotation of the radial head with firm union but no limitation of flexion, extension, supination, or pronation. There was no deformity (Figs. 49 and 50).

END-RESULTS IN FRACTURES OF OLECRANON

Of the 3 fractures of the olecranon 2 were simple and the third was compounded, the line of fracture running through the base of the olecranon process. Irrespective of the extent of the sulcus they were treated in extension by a posterior molded plaster splint, operation not being indicated in these simple fractures. In the simple fractures excellent function resulted in 6 weeks. In the third case, A. W., which was compounded, débridement was done and a molded posterior splint and secondary suture were used. A very useful limb resulted.

CASE 24. A. W., 11 years old, was admitted November 9, 1919, with a history of having fallen on his elbow 1 week before. For two days his elbow was swollen and fluctuating. A small wound over the fractured olecranon was excised and the fragments were exposed. The wound was cleaned. The smaller fragment being necrotic, a subperiosteal resection was performed. The wound was dakinized and an extension splint was applied. The wound was closed by a secondary suture and an excellent result followed. An X-ray 6 weeks later, showed the absence of epiphysis of the olecranon. Full flexion did not return for 6 months. At present there is no deformity or disability.

END-RESULTS IN POSTERIOR DISLOCATION OF THE RADIUS AND ULNA

The 23 cases of simple posterior dislocation of the radius and ulna have all been followed; 5 were complicated with a fracture and for-

ward displacement of the capitellum. All were successfully reduced under anæsthesia; 11 were immobilized in molded splints and 12 with adhesive. In the cases complicated by dislocations, complete restoration of function resulted at the end of 5 weeks. In the dislocations which were complicated by fractures of the capitellum there was no disability at the end of 3 months.

SUMMARY

Children have excellent reparative powers in fractures.

Perfect anatomical approximation of the fragments is not always essential for functional recovery.

Displacement and overriding of fragments will often result in a good functional limb and complete restoration of the bony contour.

Anatomically restored elbows may be lacking in mobility unless they are treated judiciously.

The best results are obtained by immediate reduction under an anæsthetic with the aid of the fluoroscope.

Partial immobilization with adhesive and early active motion will reduce swelling, increase muscular tonicity, and prevent muscular spasm, exuberant callus, Volkmann's ischæmic paralysis and myositis ossificans.

Passive motion with or without an anæsthetic and active massage retards progress.

Musculospiral and ulnar paralysis accompanying and following fractures about the elbow is not always permanent.

Myositis ossificans will disappear with the discontinuation of trauma to the brachialis anticus.

Open operations in children are not indicated as good functional limbs will follow displaced fragments and infections are very prone to follow open operations.

Compound fractures are best treated by débridement, Carrel-Dakin sterilization, suspension in flexion by adhesive or in a flexed Thomas splint, to be followed by secondary suture or granulation with the institution of early active motion.

I desire to acknowledge my great appreciation to Dr. Carl G. Burdick, director of the Fourth Division, for the assignment of the cases which made this study possible.

HÆMATURIA; A CLINICAL STUDY BASED ON 933 CONSECUTIVE CASES

By HERMAN L. KRETSCHMER, M.D., F.A.C.S., Chicago

IT would seem that the presence of blood in the urine is a symptom of sufficient importance to impress upon both the physician and the patient the necessity for an immediate investigation in order to determine the cause of the bleeding. Yet, many times both patient and physician minimize the importance and the gravity of this symptom, and when the bleeding stops, as it so frequently does, the patient is lured into a sense of false security; and the opportunity for an early recognition of pathology and the chance to recognize severe lesions in their incipiency are often passed by, with the result that irreparable damage has been done and in some instances the condition is beyond relief.

Hæmaturia is often intermittent in character and when the bleeding stops the patient thinks that his troubles are over. The statement has repeatedly been made that the presence of blood in the urine means the presence of organic disease in the genito-urinary tract. If this viewpoint would be assumed by all physicians, many patients who now seek relief for various urological lesions would be seen early in the course of the disease, at a time when much could be done; whereas, as so often happens, procrastination, the taking of drugs, and the putting off of a far-reaching examination result in patients coming to the urologist with far advanced lesions many of which are beyond medical or surgical relief.[1]

A review of the literature of the last 20 years shows a gradual and almost complete disappearance of the vague and indefinite terms that were used for describing the presence of blood in the urine. Essential hæmaturia, idiopathic renal bleeding, etc., are but expressions of our inability to determine the cause of the bleeding, and are generally used to "gloss over the neglect of giving the patient the benefit of a complete genito-urinary examination." There are, however, at rare times, cases in which the cause of the hæmaturia cannot be determined, and this proves that there are still limitations in our present diagnostic armamentarium. Only in 3.13 per cent of the cases in this series was a diagnosis impossible. But in the majority of instances in this series a diagnosis was established (96.86 per cent), and because of this fact a complete genito-urinary examination should always be instituted, since bleeding is indicative, with few exceptions, of serious organic disease.

In order to substantiate the statement that blood in the urine means the presence of organic disease in the genito-urinary tract, a review of 933 cases was undertaken. In this study cases of hæmaturia due to acute gonorrhœal infection; hæmaturia following the passage of sounds, cystoscopes, and bougies; and hæmaturia following injuries of the kidney, bladder, and urethra were not included, as the cause of the bleeding was obvious. Before undertaking an analysis of these cases it would seem advisable to consider briefly the duration of this most important symptom before the patient came under observation. It has previously been stated that many of these patients came in much too late in the course of their illness to have the best opportunity for treatment. A review of the histories shows that the average duration of hæmaturia or the average time that elapsed between the onset of the hæmaturia and the time at which the examination was undertaken was 2.39 years. The shortest duration of hæmaturia was 1 day and the longest duration was 35 years.

AGE

Blood in the urine may occur at any time during life, but is more frequently found in adult life than in childhood, since the lesions which produce it are more common in the later years. The youngest patient who suf-

[1] The importance of hæmaturia as a symptom has again been emphasized by Locke and Minot, Herman, Chute, Livermore, Thomas, McNeill, Jr., and MacKenzie.

fered with hæmaturia was 2 years old and the oldest, 84 years. Between these two extremes we find the ages as shown in Table I.

TABLE I.—AGE

Years	Cases
1 to 10	5
10 to 20	24
20 to 30	129
30 to 40	179
40 to 50	140
50 to 60	194
60 to 70	147
70 to 80	62
Over 80	11
Not stated	42
Total	933

SEX

Blood in the urine is more prevalent in males than in females, because in the former certain lesions, such as both benign and malignant tumors of the bladder, as well as lesions of the prostate, are common. Frequency among the sexes is given in Table II.

TABLE II.—SEX

	Cases
Male	690
Female	241
Not stated	2
Total	933

DIAGNOSTIC SURVEY

The 933 cases in this series may be divided, for purposes of study, into five groups:

Group 1. Cases in which the diagnosis was made	833
Group 2. Cases in which the diagnosis was not made	12
Group 3. Cases in which the origin of the blood was determined but not the cause	15
Group 4. Cases in which the examination was incomplete	61
Group 5. Cases in which no examination was made	12

Seventy-two cases are not included for the following reasons: (1) In 12 cases no genito-urinary examination of any sort was made; (2) in 60 cases the examination was incomplete.

In the 12 cases cited the patients presented themselves with blood in the urine or were seen in consultation at their homes with their family physician, or were seen in other hospitals, or for various other reasons no examination was made. Necessarily the question of diagnosis remained unanswered. In the other 61 cases the examination, in one detail or another, was incomplete and for this reason they are not included in the analysis. But in the remaining 861 cases the data at hand were sufficiently complete to entitle them to consideration in this study.

GROUP 1. CASES IN WHICH A DIAGNOSIS WAS MADE

Deducting the 72 cases in groups 4 and 5 there remained 860 cases which were utilized in this study. Of these 860 cases a diagnosis was made in 833 (97.86 per cent).

A certain possibility of error may obtain in some of the diagnoses, such as overlooking an early renal tuberculosis, that is masked by an acute pyelitis, or, on the other hand, a very small kidney tumor may possibly have been missed, in which events the figures of the more serious lesions found would be still further increased.

Of the 833 cases in which a diagnosis was made, hæmaturia in 331 cases (39.3 per cent) was due to *lesions of the kidney*, which, in their order of prevalence, were as follows: Tuberculosis, stone, pyelitis, malignant tumors and nephritis. It is evident, therefore, that the most frequent lesions of the kidney producing bleeding are lesions of great importance that demand early recognition and the institution of early treatment.

TABLE III.—LESIONS OF THE KIDNEY

	Cases
Tuberculosis	80
Stone	71
Pyelitis	58
Malignant tumors	37
Nephritis	31
Pyelonephritis	13
Hydronephrosis	12
Polycystic kidney	7
Suspect tuberculosis	5
Pyonephrosis	4
Syphilis of kidney	2
Pyelitis follicularis	1
Infarcts of kidney	1
Movable kidney	1
Echinococcus	1
Pyelitis of pregnancy	4
Hæmaturia of pregnancy	2
Total	331

Lesions of the bladder form the next largest group of cases in this study, a total of 307 cases (36.85 per cent). An analysis of this group showed that in 235 cases (76.5 per cent) tumor was the inciting cause of bladder hæmorrhage; that stone ranked second and tuberculosis third. This shows a somewhat different relationship from the factors in kidney bleeding, since tuberculosis, stone, and acute infections are more frequently the causes than renal tumor. It should be emphasized, however, that the tuberculosis in these bladder cases was secondary to a similar affection of the genital tract or remained after the removal of a tuberculous kidney.

TABLE IV.—LESIONS OF THE BLADDER

	Cases
Carcinoma	163
Papilloma	72
Stone	31
Tuberculosis	14
Cystitis	6
Elusive ulcer	5
Diverticulum	4
Incrustating cystitis	3
Polypi	3
Ulcer	2
Cystitis cystica	1
Chronic cystitis due to ovarian abscess	1
Bladder angioma	1
Ruptured artery in bladder	1
Total	307

Lesions of the prostate made up 126 cases, or 15 per cent of the total. Of this number benign hypertrophy was the cause of bleeding in 64 cases and carcinoma in 43. These two lesions made up 84.9 per cent of the prostatic causes of hæmaturia.

TABLE V.—LESIONS OF THE PROSTATE

	Cases
Hypertrophy	64
Carcinoma—	43
Prostatic bar and bladder diverticulum	5
Stone	4
Prostatic bar	3
Tuberculosis	3
Abscess	2
Hypertrophy with carcinoma of bladder	2
Total	126

The next group, in frequency of occurrence, are *lesions of the ureter*. The total number of cases in which blood was present was 54, of which 48 were due to stone.

TABLE VI.—LESIONS OF URETER

	Cases
Stone	48
Stricture	5
Carcinoma	1
Total	54

If traumatic lesions and acute gonorrhœal infection are excluded, *urethral lesions* are very rare as causative agents of bleeding. Table VII mentions them.

TABLE VII.—LESIONS OF THE URETHRA

	Cases
Papilloma of urethra	2
Stricture of female urethra	2
Prolapse of female urethra	1
Polyp of post-urethra	1
Total	6

The group of *general disease* in which hæmaturia occurred, numbered 9, or 1.08 per cent of the total number of 928 cases. The cases of cirrhosis of the liver may be open to question, but in view of the fact that this group was very carefully studied and no other diagnosis was made, they are included at their face value.

TABLE VIII.—GENERAL DISEASE GROUP

	Cases
Purpura	4
Cirrhosis of liver	2
Hæmophilia	1
Banti's disease	1
Phosphaturia	1
Total	9

GROUP 2. CASES IN WHICH A DIAGNOSIS WAS NOT MADE

In 12 cases (1.3 per cent) neither the origin of the blood nor the cause of the hæmaturia was determined, this in spite of the fact that all the patients were subjected to a very complete urological study. *These patients were seen at a time when there was no active bleeding, and all modern methods of examination were negative.*

By reason of the fact that this group of patients gave no evidence of hæmaturia several possibilities suggest themselves: (1) that the hæmaturia was due to a stone which was passed before the patient came under observation; (2) that on account of the chemical composition of the stone it could not be

demonstrated with roentgen rays; (3) that the hæmaturia was provoked by an early renal tuberculosis, such as an early tuberculous involvement of one of the papillæ, though no evidence of tuberculosis was obtained during the time the patient was under observation; (4) that the bleeding was due to an acute infection of the kidney which had run its course, so that at the time the patient came under observation no evidences of infection were present; (5) that there is the possibility of a small tumor having been overlooked; (6) that gross bleeding, at times, is the only, and sometimes the first, symptom of nephritis; no doubt if the cases in this group could be followed through for years, this point could be proved or disproved. (7) That on account of 8 of these 12 cases being females, the possibility of error should be taken into consideration, i.e., the blood in the urine may have had its origin in the genitalia.

GROUP 3. CASES IN WHICH THE ORIGIN WAS DETERMINED BUT NOT THE CAUSE

In 15 cases the origin of the blood was determined but not the cause, the failure finally to determine the cause being due to the fact that the patient failed to return for further urological study. Doubtless the cause could have been determined in some of them had the patients remained under further observation. These cases really belong in the group of cases in which the examination was incomplete, but in view of the fact that the origin of the blood was determined they are included in a separate group.

Associated symptoms. Even if one were inclined to minimize the importance of hæmaturia in this series of cases, there were enough co-existing symptoms present to focus the attention of both physician and patient upon the fact that further investigation was necessary. An analysis of the cases showed that pain was very frequent and that it varied in character, degree, and radiation, depending upon the seat of the primary lesion producing the hæmaturia. Often the pain was due to the passage of clots. In view of the fact that the lesions producing the blood vary greatly in character, it is natural to expect that nothing definite as regards symptomology will result. The following symptoms were noted.

Pain	625
Frequency	603
Pus	599
Burning	328
Passing clots	226
Retention	108
Fever	104
Vomiting and nausea	112
Chills	96
Casts	53
Tubercle bacilli	18

To reiterate for the sake of emphasis the statement will be made that tumor or new-growth was the most frequent cause of bleeding. In 325 cases tumor somewhere in the urinary tract provoked the blood. If benign hypertrophy of the prostate is regarded as a new-growth, 64 more cases may be added, and a total of 389 cases, or 46.9 per cent, of all causes of hæmaturia are due to new-growths, will be reached. Stone ranked second as the causative factor of bleeding, being present in 154 cases, or 18.5 per cent; and tuberculosis, third, in 97 cases, or 11.7 per cent. As previously stated, it is possible that some of the cases of renal tuberculosis were missed, in which event these figures would be still higher. Acute infections were present in 89 cases, or 10.7 per cent, and nephritis was the cause in 27 cases, or 3.2 per cent.

SUMMARY

1. Hæmaturia is only a symptom, but it should always be considered as indicative of the presence of serious organic disease in the genito-urinary tract.

2. Every case of hæmaturia should be subjected to complete, comprehensive genito-urinary examination to determine, first the origin of the blood, and second the cause of the bleeding.

3. There is never any justification for treating cases of hæmaturia on a purely symptomatic basis.

4. This series proves the important assertion, so often repeated, that the most frequent causes of hæmaturia are tumor, stone, tuberculosis, infection, and nephritis.

PROLAPSE OF THE FEMALE URETHRA[1]

By THOMAS J. WATKINS, M.D., F.A.C.S., Chicago

THE subject of prolapse of the female urethra would seem to be a trite one to present to a special society. The literature and clinical observation, however, indicate a great diversity of opinion relative to the etiology and operative repair of urethral prolapse. An effort will be made to avoid much detailed discussion.

This paper is chiefly concerned with downward displacements of the entire urethral body and will casually refer to prolapse of the urethral mucosa through the meatus, and herniation of the mucous membrane through a rent in the urethrovaginal fascia.

FREQUENCY

Urethral displacements comprise the large majority of urethral diseases; malformations, infections, and new-growths being relatively infrequent.

ETIOLOGY

Urethral displacements are almost solely the result of traumatism of labor. The tension upon the fascia which causes the lesion is chiefly produced by downward pressure of the fetal head on the cervix, or by traction in forced delivery. If this be true, easy and early retraction of the cervix prevents displacement of the body of the urethra. Senile atrophy and infection are prominent factors in prolapse of the mucosa (caruncle).

PATHOLOGY

Urethrocele is sagging of the entire urethral body due to injury of the vesicovaginal fascia. The lesion is essentially a transverse rent or attenuation in the upper portion of this fascia. If the fascia is put on longitudinal tension by pressure from above, the injury must be essentially transverse. The part near the cervix is usually injured because of its relation to pressure and because of its relative strength. Thorough dissection in cases of urethrocele also shows the lesion transverse (usually ragged) at the upper part of the vesicovaginal fascia. The fascia is otherwise generally found completely intact. In sagging, the urethral body rotates on the pubic bone without being much displaced from the bone. In an occasional instance the upper may be slightly more displaced than the lower portion of the urethra. The so-called "funnel-shaped urethra" may be very rare.

Stretching, retraction, and fixation are important factors in the development of all herniæ and especially so in this one. The retracted fixed tissue in urethrocele is found behind the pubes, to either side of the base of the urethra (this fact bears an important relation to mobilization and suture).

Injury to the vesical sphincter involves stretching, tearing, retraction, and fixation without destruction or atrophy—comparable to injuries of the sphincter ani. In both, irreparable damage seldom, if ever, occurs.

Increased mobility of the inner tube (the mucous membrane of the urethra) is present when there is much protrusion of the mucosa through the meatus. This is easily demonstrated by dissection as will be noted later. Emmet devised his "button hole operation" for the cure of this lesion. Emmet's work on prolapse of the urethral mucous membrane has not received deserved consideration.

Chronic infection of the bladder, the result of increased residual urine, is important in the pathology of urethrocele, as observed and recorded by my associate, Arthur Curtis.

We have had only 1 patient with a distinct lesion in the urethrovaginal fascia. A hernial canal was present near the base of the urethra, was about ½ inch in diameter, and contained a distinct diverticulum of the urethral canal, simulating a cyst. Symptoms were absent except for protrusion.

SYMPTOMATOLOGY

Distress from urinary incontinence (generally partial), from mechanical disturbance of protrusion and from irritable bladder, due to chronic infection, comprise the chief symptomatology.

[1] Read before the Chicago Gynecological Society, January 16, 1925. (For discussion see p. 723.)

DIAGNOSIS

There is little danger of mistaking urethrocele except for cyst of the anterior vaginal wall. The presence of cyst is easily determined by passing a ureteral sound. The extent of displacement is determined by pushing the urethra upward toward the cervix by means of the palm of the finger placed on the body of the urethra. The distance so replaced represents the extent of the urethrocele, as the urethra is normally in a fixed location. In doubtful cases examination in the standing or squatting position is of great value.

TREATMENT

The treatment of urethrocele is entirely operative. The indications for operation are the presence of other pathology necessitating repair and incontinence of urine. Uncomplicated urethrocele is seldom observed.

If the etiology and pathology given are correct, urethrocele is always associated with cystocele. This necessitates thorough dissection of the anterior vaginal wall. When this is done the type and extent of the lesion can be readily determined, and successfully repaired by utilizing the established principles of herniotomy.

Important features in the operative repair are free mobilization at the chief site of retraction, transverse suture at the site of injury of the vesicovaginal fascia so that the sag of the urethra will be corrected, and care in bringing firm tissue together over the base of the urethra, as recommended by Kelly some years ago. Discussion of detailed technique at this time does not seem to be necessary.

PROLAPSE OF THE URETHRAL MUCOUS MEMBRANE (CARUNCLE)

Mild cases may be treated by topical applications, cautery, fulguration or radium. It is important to recognize the acute case, due to infection, which will respond to simple treatment.

We have been interested in the operative treatment of the rather extensive type with freely movable and redundant mucous membrane. In a few such cases we have obtained very satisfactory results with a modified Emmet operation, the modification consisting in not opening the urethra or excising the redundant tissue. A longitudinal incision is made through the urethrovaginal fascia; the "inner tube" is dissected enough so that it may be pulled without undue tension into the wound sufficiently to restore the prolapsed mucosa within the urethra when it is fixed by sutures. A narrow strip of fascia is left attached to the mucous canal along the midline so that the fixation sutures do not penetrate the mucosa. The redundant mucosa so replaced has given no trouble.

RESULTS

Thorough dissection in the repair of prolapse of the urethra always seems to supply a sufficient amount of firm fascial tissue for successful repair. Failure to obtain *satisfactory* urinary control has been due, I believe, to errors of judgment or defective technique rather than to the absence of tissues.

SUMMARY

1. Urethrocele is usually associated with cystocele.

2. The lesion is generally a transverse ragged tear or attenuation of the upper part of the vesicovaginal fascia.

3. Successful repair requires thorough dissection of the anterior vaginal wall, free mobilization, and care in approximation and suture.

4. The probabilities of cures should be excellent as strong fascial tissues can be utilized.

RESIDUAL URINE IN WOMEN[1]

By ARTHUR H. CURTIS, M.D., F.A.C.S., Chicago
From St. Luke's Hospital

THERE appears not to have been sufficient recognition of the frequency or importance of residual urine in women. Also, although the leading gynecological clinics have most heartily supported our views, there is still a lack of uniformity in the management of this disturbance in vesical function.

Residual urine occurs not only in association with cystocele, in the puerperium and after operation; it frequently develops during the course of pregnancy and may result even from no greater cause than habitual distention of the healthy bladder.

Previous to 1915, when we first called attention to the frequency of this condition, our patients had much trouble with postoperative urinary tract infection; among our most dreaded "ghosts" were those who returned to our office after operation, or labor, complaining of varying degrees of bladder discomfort.

After 1915, upon realization of the importance of residual urine, we instituted the present plan of postoperative treatment. At the same time there was begun a detailed study of urinary tract symptoms in all patients on our service. This included our personal bacteriological investigation of the urine in all cases of suspected infection. A complete report of this clinical and laboratory study, made in 1922, covered a series of 1,595 patients.[2] Since that time, observations have been continued but special investigation has been limited to those cases presenting features of unusual interest.

In the few minutes at my disposal I wish, for the sake of clarity, to briefly outline our management of these cases and will also, without detail, tell you the results which we have obtained.

MANAGEMENT OF BLADDER AFTER OPERATION

Use of the catheter is avoided when possible, but no patient is allowed to suffer from distention.

Failure to urinate within several hours after return from the operating room is not, in itself, sufficient reason for catheterization; distress should be the chief indication. It is true that marked distention should be relieved but this does not often occur in the absence of notable pain. Provided the catheter has not been required, the presence of some residual urine for a few days is not a particular menace.

Patients who require repeated catheterization almost invariably fail to recover immediately the power of complete evacuation upon resumption of spontaneous micturition. There usually ensues a period of several days during which residual urine is present. It is the daily withdrawal of this residual urine which is responsible for our present improved results. Catheterization, immediately after urination, preferably with slight bladder lavage, should be repeated once each day until residual urine disappears.[3] Instillation of a small amount of antiseptic solution before withdrawal of the catheter, e.g., ½ ounce of ½ per cent mercurochrome, is a helpful adjunct. We also give urinary antiseptics by mouth.

RESULTS

In contrast with previous experience, we now find that persistent postoperative urinary tract infections have disappeared. Temporary mild cystitis may occasionally occur, but this is promptly disposed of. The much dreaded "catheter" cystitis and pyelitis have been eradicated. Similar favorable reports are obtained from the clinics of John G. Clark, Richard R. Smith, Reuben Peterson, and George Gray Ward.

Serious infection has become so uncommon that its appearance is always an indication for inquiry into the patient's previous history. In fact, we confess having thus unearthed a previously existing tuberculous infection of the kidney and 1 case of colon bacillus pyelitis which had been overlooked.

[2] Curtis, A. H. Management of the female urinary bladder after operation and during pregnancy. J. Am. M. Ass., 1923, lxxx, 1126.

[3] Innumerable tests, immediately after voluntary urination, have revealed that the normally functionating bladder rarely retains more than 20 cubic centimeters.

[1] Read before the Chicago Gynecological Society, January 16, 1925. (For discussion see p. 724.)

It should be noted that some patients complain of the discomforts of catheterization and urethral fissures occasionally develop. To avoid the latter the catheter must be firm and should be lubricated with solid petrolatum. Another minor flaw in our present method of management is the occasional need of a somewhat longer stay in the hospital because proper care demands attention to the bladder until residual urine disappears.

CONCLUSIONS

1. Residual urine is of frequent occurrence in women.

2. Provided postoperative (or postpartum) catheterization has not been necessary, the temporary presence of some residual urine is not a particular menace and seldom demands treatment.

3. It is unnecessary to torture patients through refusal to catheterize when the full bladder causes distress. We need only to realize that those who require repeated catheterization do not recover immediately the power of complete evacuation upon return of spontaneous micturition. In such cases, daily withdrawal of residual urine until function becomes normal affords excellent prophylaxis against urinary tract infection.

NOTE.—The discussion of this paper as found on p. 724 is most important, and as it brings out a new phase of the subject, the reader is requested to read this discussion.

THE SEDIMENTATION TEST IN OBSTETRICS AND GYNECOLOGY[1]

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FAHRAEUS (7), in 1907, made the observation that if citrated blood from a pregnant woman is allowed to stand in a tube, the erythrocytes will separate from the plasma and settle to the bottom of the tube. The rate of settling down or "sedimentation time" of the erythrocytes varied in different specimens as well as in different periods of pregnancy. It had been known for centuries that blood from a patient suffering from any inflammatory disease, if allowed to stand, would separate out into two portions, one serum and one erythrocytes, thus forming the "crusta phlogistica" of the ancients first described by Galen (13). John Hunter (24) in 1791 first noticed that the speed of sedimentation varied in different specimens. Interest in this reaction was revived during the middle of the last century by Davy (5), Lehman (28), Mueller (37), and Nasse (38) all of whom studied this reaction but were unable to explain it or to correlate its various phases. After Fahraeus made his original observation on the blood of pregnant women, he began to investigate this phenomenon in patients suffering from acute infections and found that the rate of sedimentation varied greatly in different types of infections and even in different periods of the disease in any one patient. Linzenmeier (30) then undertook studies of the sedimentation time throughout the different periods of pregnancy, labor, and the puerperium. This was done in the hope of evolving a definite and accurate early test of pregnancy. He soon abandoned this idea, however, and began to study the sedimentation rate in all forms of gynecological pathology with special reference to the inflammatory conditions, where, it will be shown later, the most marked changes in rate occur.

The sedimentation time, or rate, is the number of minutes required for the red blood cells to separate from the plasma of citrated blood. Many methods and types of tubes for making such determinations have been devised. The technique of Linzenmeier appears to be the most reliable, the most accurate, and also the simplest of all the various methods that have been suggested and it was therefore used in all cases reported in this investigation. Abderhalden (1), Graegert (16), Kok (26), and Horvat (23), all recommend this method and especially Friedlander (11) who states that it is the method most free from error. He also makes a strong plea for the adoption of this method by all investigators in order that all reports may be expressed in similar terms and thus be comparable.

The tubes used in the Linzenmeier method as modified by Friedlander are hard glass tubes 5 millimeters in diameter and 6.5 centimeters in length and have a capacity of more than 1 cubic centimeter. They are marked at the 1 cubic centimeter point and also at 6, 12, 18, and 24 millimeters below this mark. The tubes, as well as the syringe with which the blood is drawn from one of the superficial veins at the elbow, must be perfectly clean and dry. Two-tenths of a cubic centimeter of a 5 per cent sodium citrate solution is drawn into the syringe and then 0.8 cubic centimeter of blood. This is shaken until mixed and then placed in one of the tubes and allowed to stand at room temperature. The blood mixture level must be exactly at the 1 cubic centimeter mark. The time is taken when the mixture is placed in the tube and again when the line of demarcation between the erythrocytes and the plasma reaches the 18 millimeter mark; a millimeter reading is also taken at the end of 1 hour. This latter reading has been recently recommended by Linzenmeier (34) and also by Geppert (14) as being more comparable than the number of minutes required for the line of demarcation to reach the 18 millimeter mark and both types of readings are therefore used in this report. Another advantage of the 1 hour reading lies in the fact that much time can be saved in specimens requiring several hours for complete sedimentation.

[1]Read before the Chicago Gynecological Society, January 16, 1925. (For discussion see p. 722.)

The sodium citrate solution must be comparatively fresh as Geppert has shown that variations occur with old solutions. The tubes must be kept vertical (Berczeller and Wastl, 2) for slanting the tubes increases the rate appreciably. If the blood clots before being well mixed with the citrate solution, the test is valueless. Friedlander and others have claimed that the mixture may be shaken and the readings taken for a second or even a third time but Linzenmeier states that the second reading is always more rapid than the original one. We have found a variation amounting to as much as 10 per cent due to the fact that the erythrocytes never become thoroughly remixed in the plasma.

Rothe (43) has divided the sedimentation period into three distinct phases: the first or "pre-agglutination period" with slow sedimentation, the second or "agglutination period" with rapid sedimentation, and a third or "period of packing" when the sedimentation slows again and finally ceases because the erythrocytes are packed in the bottom of the tube as closely as possible. He does this because he is of the opinion that readings should be taken every 5 minutes and curves plotted from these results. Linzenmeier, Kok, and others also feel that the plotting of curves based on 5 minute readings is of value but we have been of the opinion that too much unnecessary detail is thereby involved. For practical purposes, readings taken at the end of 1 hour and also when the erythrocyte level reaches the 18 millimeter mark seem to suffice.

Many investigations have been undertaken to determine, if possible, the mechanism of this sedimentation phenomenon and the factors involved. As yet none has seemed to be successful nor has any satisfactory theory been advanced to account for the various changes in rate and character of the sedimentation. Fahraeus, Hueber (25), Vorschutz (52) and Clausser (4) hold that the erythrocytes carry negative charges and therefore repel each other. Agglutinins carry positive charges and, when these are increased in the blood stream, they take up the negative charges of the erythrocytes. The latter no longer repel each other and therefore clump together in a massive rouleau formation. Fahraeus later (8) states that the globulins and the fibrinogen content play a rôle in the suspension stability of the erythrocytes. Salomon (46) also finds a parallelism between globulin content and sedimentation. Starlinger (49) also believes that the fibrinogen content is a factor but Linzenmeier has shown that defibrinated blood gives the same results as though the fibrinogen were not removed.

Abderhalden, Clausser, and Linzenmeier feel that there must be a change in the viscosity to bring about a change in sedimentation but all are unable to determine whether this is due to a disturbance of antibody balance or to albumen and globulin content. That the number of immune bodies present in the blood stream plays a rôle is evident (Linzenmeier, Leenderetz, 29, Oettingen, 41) as is also the lipoid balance, and the question resolves itself into a consideration of the physicochemical reactions of the plasma proteins. The problem is still unsolved, however, and in fact is becoming more involved as more workers become interested in this subject.

Another factor entering into the maintenance of the suspension stability of the erythrocytes must be the erythrocytes themselves. Buerker (3) has shown that the sedimentation is more rapid in pernicious anæmia and very slow in chlorosis. The rate of sedimentation is therefore inversely proportional to the erythrocyte count. The sedimentation rate is also very slow in the secondary anæmias.

It would seem, therefore, that after all the theories and experiments regarding the etiology of the changes in the sedimentation rate have been studied, no definite conclusions can be reached. All of the above mentioned factors have some part in this reaction but nothing more definite can be said at the present time. The question is still unsolved and offers a fertile field for further investigation.

Many workers have studied the sedimentation time in normal, healthy, non-gravid women who were apparently free from any foci of infection. Linzenmeier gives as his findings a time of 200 to 350 minutes for the sedimentation to reach 18 millimeters; Grae-

gert considers any reading over 180 minutes as normal; Flores (10) states that the normal limits are 180 to 240 minutes; lastly Friedlander finds that the sedimentation time is between 600 to 1,000 minutes. Our findings in normal women range from 132 to 370 minutes, with a rate of 5 to 7 millimeters during the first hour.

In the early cases of pregnancy our results have been disappointing and from our findings it must be concluded that the sedimentation test is not an accurate early method of diagnosis. Fahraeus, in his report, holds that a definite diagnosis of pregnancy can be made during the first 3 months and states that the rate is always under 120 minutes. Linzenmeier finds that the rate is under 120 minutes only during the second half of pregnancy and later states that the test is not specific and of no value in establishing the diagnosis of pregnancy, Gueissez (20), Pewny (42), Vignes and Hermat (51), Flores and others are all of the opinion that the test is not accurate until pregnancy has advanced so far as to make this procedure unnecessary.

We have examined 100 pregnant women at various periods of pregnancy, depending upon the time of the first visit to the Prenatal Clinic of the Michael Reese Hospital and were careful to exclude all cases which appeared to have any foci of infection such as infected tonsils, infected or carious teeth, sinus infections, cholecystitis, etc. After the twentieth week we obtained but one reading over 120 minutes and this same case was the only one under 10 millimeters in 1 hour. The average sedimentation time after the twentieth week of pregnancy was 43 minutes with a sedimentation of 24 millimeters during the first hour. Before the twentieth week, the average sedimentation time was 87 minutes with an average sedimentation of 14 millimeters during the first hour. These readings are rather low but we feel that this is due to the fact that unusual care was used in excluding all possible foci of infection.

The average sedimentation time after the twentieth week is low enough to be distinctive and perhaps diagnostic, but during this period no such test is necessary to establish a definite diagnosis. Before the twentieth week, when questions arise as to the diagnosis of pregnancy and especially as to the differential diagnosis between pregnancy and growing myomata, the sedimentation test is of little value. In cases of myomata we have found the average sedimentation time to be 104 minutes. This agrees with Molnar (36), Flores and Linzenmeier, although Grisi (19), Schumacher and Vogel (47), and Friedlander report normal sedimentation rates in uncomplicated myomata.

In connection with the sedimentation time in pregnancy, it is of interest to note that Fabroni (6) examined a series of cases during the premenstrual period and found, in all of them, a definite increase in the sedimentation rate. He concludes, therefore, that there must be an analogy between the premenstrual period and pregnancy and that the blood of the premenstrual period must be of the same composition as the blood of the pregnant state.

In cases of threatened abortion, the sedimentation test is of little significance. It is of great value, however, in cases of abortion in progress or incomplete abortion, in the determination of the presence or absence of infection, and it is in such cases that the test should be used.

CASE 1. Mrs. A. H., age 36 years, with last menses 6 weeks previous to admission, entered the hospital complaining of vaginal bleeding for the past 2 days. Temperature was 100°, pulse 90, and the white blood cells 9,600. She did not have the appearance of being septic. The sedimentation time was 50 minutes for 18 millimeters and 19 millimeters in 1 hour. Twenty-four hours later the white blood cells had risen to 14,000 and the temperature to 102. The patient now looked septic.

Since Linzenmeier's dictum, that any patient with a sedimentation time of less than 60 minutes is suffering from an acute infection, is accepted by all workers as being a correct one, then it can readily be seen that the sedimentation test in this case showed the presence of an acute infection at least 24 hours before the leucocyte count or the temperature, and must, therefore, be more sensitive and respond more rapidly. That this is so is illustrated by the following case.

CASE 2. Mrs. B. K., age 28 years, para-ii, with last menses 6 weeks previous to admission to the hospital, complained of vaginal bleeding and cramps

in the lower abdomen. On admission the temperature was 101, white blood cells 15,000 and the sedimentation time 6 minutes for 18 millimeters and 36 millimeters in 1 hour. On the third day, the temperature was 101, white blood cells 17,000 and sedimentation time 7 minutes and 35 millimeters in 1 hour. On the fifth day, the temperature was 100, white blood cells 17,000 and the sedimentation time 13 minutes with 34 millimeters in 1 hour. On the fifteenth day, the temperature was normal, the white blood count was 15,000, and the sedimentation time 23 minutes and 28 millimeters in 1 hour.

In the above case on the third day, the temperature and leucocyte count had remained stationary but the sedimentation time showed signs of improvement. This was borne out by the subsequent clinical course although on the eighth and fifteenth days with normal temperature, the sedimentation time still showed an acute infective process. This case had a long and protracted course and showed persistent tenderness in both adnexæ and a discharge for 4 weeks. This case also shows the prognostic value of the sedimentation test, which will be discussed later.

Frommolt (12), in a very extensive investigation of 338 cases of abortion, showed that 46 per cent of those with a sedimentation time under 60 minutes developed temperatures of 100.4 degrees while only 16 per cent of those whose sedimentation times were over 60 minutes developed temperatures of 100.4. He also finds that a decrease in time can be determined before the fever develops and he emphasizes the fact that the faster the rate, the more certain and the more virulent is the infection.

The sedimentation test would seem to be of great value in inflammatory adnexal disease not associated with pregnancy. Especially is this true in those cases in which a question arises as to the presence or absence of a latent infection or to the differential diagnosis between pyosalpinx and ovarian cysts, retroversions of the uterus or intraligamentary tumors. At the present writing, the sedimentation time seems sufficiently reliable as an index of the presence or absence of an infection to warrant the position of such investigators as Friedlander, Geppert, Grisi, Haselhorst (21), Hildebrandt (22), Rumpf (45), and Molnar (36), that a routine sedimentation test should be done in all cases before gynecological laparotomies are performed. Friedlander emphasizes the frequency with which latent infections are stirred up by operation and states that since he waits for the sedimentation time to reach 2 hours before operation, he has encountered no acute lighting up of a latent infection during the postoperative course that was not recognized before operation. Haselhorst operated on a series of 200 cases with sedimentation times of more than 2 hours and in none of them did he find pus. Three cases showed redness, some swelling, and a few recent adhesions.

We have studied such a series of cases, of which the following will serve as typical illustrations.

CASE 3. Mrs. B. H. was admitted to the hospital complaining of dysmenorrhœa, leucorrhœa, and sterility. Temperature was 99.2, white blood cells 13,800, and there was marked tenderness in both adnexæ. The sedimentation time was 18 in 132 minutes and 8 millimeters in one hour. Laparotomy revealed a salpingitis isthmica nodosa with a few old adhesions.

This case in spite of a leucocytosis of 13,800 and a temperature of 99.2 showed a sedimentation time of 132 minutes which disproved the presence of any acute infection.

CASE. 4. Mrs. M. F., age 22 years, complained of colicky abdominal pains in the right lower quadrant and vaginal bleeding for the past week. The abdomen was somewhat tense and there was some muscle reaction. There was a freely movable pear-shaped mass of the left adnexa. Temperature was 99, white blood cells 13,400, and the sedimentation time was 24 minutes with 26 millimeters in 1 hour. A tubo-ovarian abscess was found on laparotomy and the patient had a stormy and febrile convalescence.

This case demonstrates the manner in which a case with a subacute or latent infection may light up postoperatively. The presence of this infection was indicated by the rapid sedimentation time and yet the leucocyte count was the same as that of the previous case in which no such infection was present. Here the sedimentation rate was a more delicate and a more accurate index of the presence of the infection and a better test of the virulence of this infection than the leucocyte count.

The next 2 cases, both errors in pre-operative diagnosis, are especially instructive.

CASE 5. Mrs. R. C. had complained of abdominal pain and a vaginal discharge for 5 months. The temperature was 99.8, white blood cells 13,000 and vaginally a large tender mass could be felt to the left and posteriorly. The sedimentation rate was 95 minutes with 12 millimeters in 1 hour. With a pre-operative diagnosis of left pyosalpinx, a laparotomy was performed which revealed an adherent retroversion of the uterus with no evidences of a recent infection.

CASE 6. Miss R. B., age 21 years, complained of loss in weight and abdominal pain. Temperature was 98.6, white blood cells 12,000 and the sedimentation time was 174 minutes and 6 millimeters in 1 hour. Dictation by several examiners read, "Rectally a small soft mass can be felt in both adnexæ." The pre-operative diagnosis was tuberculous salpingitis(?). Laparotomy showed normal tubes, ovaries, and uterus.

In both of these cases, the leucocyte counts and the physical findings pointed toward the presence of infective processes in the pelvis, while the sedimentation tests ruled out any such infections. The latter was borne out by the operative findings.

The following case illustrates the value of the sedimentation test as a means of differentiating inflammatory adnexal tumors from new growths.

CASE 7. Mrs. E. H., age 30 years, was admitted to the hospital complaining of fever, nausea, and an abdominal pain which began 1 week previous to admission as a generalized abdominal pain which later localized in the right lower quadrant. Her menstrual history was normal, the last period occurring 1 week previous to the present illness. Temperature was 99, white blood count 14,000, and the sedimentation time 11 minutes with 38 millimeters in 1 hour. Vaginally a large cystic mass could be felt in either half of the pelvis, the right one being freely movable and the left one being adherent in the Douglas. Neither mass was apparently connected to the uterus which was small, freely movable and pushed up against the symphysis. Laparotomy, although contra-indicated by the sedimentation test which showed the presence of an acute infection, was done and revealed bilateral pyosalpinx with small ovarian cysts.

The sedimentation test is also of great value from a prognostic point of view in cases of sepsis, whether puerperal, postabortive or postoperative. It is more sensitive and responds more rapidly than does the leucocyte count to increased virulence of the infection and therefore shows any changes more rapidly than either the leucocyte or the temperature curves.

CASE 8. Mrs. R. M., primipara, age 19 years, was admitted to the hospital 4 weeks postpartum, having been delivered in her home. She complained of fever, lassitude, and pain along her right leg. The lochia was foul and there was a marked thrombophlebitis of the right leg. The patient had the appearance of being quite septic and was very restless.

Day	Temperature	White blood cells	Sedimentation time	
			Minutes	Millimeters in 1 hour
1	102.2	10,600	7	38
5	101.2	10,600	12	36
7	101	10,400	17	28
14	98.6	10,000	25	26

In this case it will be seen that on the fifth and seventh days the leucocyte count and the temperature remained about the same, while the sedimentation time was steadily and rapidly increasing. On the basis of this increase in time, a good prognosis was given and the patient made a slow but steady recovery.

CONCLUSIONS

1. The sedimentation test is apparently of no value in the early diagnosis of pregnancy.
2. The sedimentation test is useful in determining the presence or absence of infection in the body. With pelvic pathology, a negative sedimentation test (a sedimentation time over 2 hours) conclusively rules out pelvic infection.
3. The rate of sedimentation is directly proportional to the virulence of the infection.
4. The test is a further aid in determining the safe time for operation.
5. The sedimentation test seems a more delicate prognostic index, good or bad, than either the leucocyte or temperature curve.

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DEPARTMENT OF TECHNIQUE

MANAGEMENT OF OCCIPITOPOSTERIOR POSITION[1]

With Special Reference to the Application of the Kjelland Forceps

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OCCIPITOPOSTERIOR positions of the vertex occur so frequently and are sometimes associated with such serious results that one ought not to make an apology for presenting the management of these cases for consideration.

The obstetrical specialty, although a limited one, is almost an exact science, particularly when we deal with the relation of the passenger to the passage as we are guided by standard measurements of the pelvis and the fetal head. In spite of this fact the mode of procedure in the management of obstetrical complications is varied, depending upon the opinions of the accoucheur.

In persistent occipitoposterior positions it is axiomatic that a successful termination depends upon flexion and rotation of the head by maneuvers least dangerous to the life of the child and subsequent damage to the mother. In this paper I wish to corroborate the successful results obtained in these cases by the new method of application of the Kjelland forceps.

The occurrence of this complication according to most writers is about 20 per cent. Geddes in 300 cases found that 10.5 per cent of the posterior positions occurred in multiparæ and 20.8 per cent in primiparæ. Fortunately, spontaneous rotation takes place in a great percentage of these cases if the case is left to nature after a reasonable test. It is evident that this malposition prolongs labor. In 1,000 cases analyzed by Rice the average prolongation of labor in primiparæ was 4 hours and in multiparæ 3½ hours.

In spontaneous rotation the occiput comes down with the head well flexed meeting the resistance of the pelvic floor and with good uterine contraction pushes the head forward so that it turns from the opposite sacro-iliac synchondrosis to a position under the pubic arch.

In another group of cases the head is not well flexed. Instead of the anterior fontanel being opposite the acetabulum, the frontal eminence is opposite to it.

Early in labor one frequently finds the head engaged in the transverse diameter, in cases with normal pelvis, and as labor advances the head changes into the oblique. Contrary to some of the modern new theories, the older textbooks teach us that the head always engages in the oblique diameter; therefore when labor progresses slowly with incomplete flexion rotation, you get deep transverse arrest of the head in the pelvis.

The diagnosis of occipitoposterior position ought to be made early and is not difficult unless the patient is obese or has a rigid abdominal wall; one can at onset of labor diagnosticate by abdominal palpation the direction of the fetal ovoid, presence of small, irregular and nodular parts, situated in the median line. Auscultation may sometimes be of aid, for the heart sounds are usually heard toward the flank to which the back is directed.

Vaginal examination reveals some of the characteristics which make the diagnosis positive. The cervix is usually not taken up as the presenting part does not press firmly against the lower segment. The location of the large and small fontanel can be easily felt. The sagittal suture can be felt to lie across the oblique or transverse diameter. If labor is advanced it is sometimes difficult to diagnose the various sutures and the fontanels on account of the overlapping sutures. In that event the ear must be located and it will point in the transverse diameter or toward the sacrum, indicating the direction of the occiput.

After all is said and done regarding the diagnosis of occipitoposterior positions, the suggestive signs in the history of labor are almost pathognomonic. When a patient gives a history of early ruptured membranes, primary inertia, slow progress in labor pains, especially when referred to the back, with slight uterine contractions, one can be justified in making a snap diagnosis of mal-presentation of the head without examination.

Nearly every obstetrician has had in his personal experience or has been called to see with other

[1]Read before the Harlem Medical Society, March, 1924.

men cases in which repeated unsuccessful attempts with forceps had been made, and on examination has found the cause of the failure to be an undiagnosed occipitoposterior position.

In considering the management of these cases, assuming early diagnosis, I will divide the cases into the following groups.

1. When the head is unengaged with the membranes intact and the large diameter of the head above the brim.

2. When the head is engaged in the pelvis but still above the spine of the ischium.

3. When the head is low down in the pelvis.

In the first class of cases, a great many authorities have advised external manipulation of the anterior and posterior shoulders. Personally I have never succeeded and usually leave these cases to take their normal course with watchful waiting. If, however, the membranes have ruptured, the amniotic fluid has drained away, and the cervix is not dilatable, it is advisable to introduce a hydrostatic bag to aid dilatation of the cervix and thus shorten labor.

In the second group, when the head is in the parturient canal and when the occiput remains persistently posterior in spite of a long test given for spontaneous rotation, there are several methods advocated.

1. Leaving the case to nature hoping for spontaneous rotation.

2. Manual rotation of the head with external rotation of the shoulders. A recent maneuver recommended by Lamond Lackie is one in which the operator passes his hand beyond the head intra-uterine to the shoulder, and rotates the trunk by the internal hand. This maneuver is not simple.

3. Manual rotation with forceps extraction.

4. Forceps extraction with the occiput remaining in the posterior position.

5. Podalic version.

In the third group, double application of forceps with its many modifications recommended by Scanzoni has been advised especially when the head is low down.

With regard to leaving the persistent occipitoposterior position to nature, it is advisable to permit a reasonable test of labor, by that I mean not to test the endurance of the mother but to observe her accomplishments in a definite period of time, not more than 2 hours in the second stage, and then proceed as advisable. It seems to me it is criminal neglect to wait for exhaustion of the mother or impending death of the child before interference is begun. In reference to manual rotation, one cannot always achieve success with this maneuver alone without intra-uterine manipulation harmful to the mother. The question of version in occipitoposterior position especially when labor is well advanced with the head in mid-plane is a momentous one, for in the hands of the average obstetrician the procedure is so dangerous that it ought not to be advocated as a method of choice.

Up to the present time the methods which have rendered the best results in the treatment of these cases are extension and rotation of the head with forceps followed by extraction.

This maneuver necessitates the application and reapplication of forceps which are not always easily applied, and some have advocated a two-forceps maneuver which has given excellent results.

A word about the Kjelland forceps before I attempt to advocate their use. A great many forceps have been invented within recent years, and a great many changes in modification are continually being made, but we must admit that the forceps universally accepted as the best are those with the Tarnier axis—traction forceps. In spite of this fact the only advantage gained by this instrument is the question of traction. The biparietal application with Tarnier forceps when the head is in the mid-plane is just as difficult as with the ordinary forceps, Simpson or Elliott. This difficulty in application led Kjelland to invent a new model with which the application of forceps in mal-positions of the head was simplified and easy delivery made possible.

The new model forceps should not be applied in a contracted pelvis but only in cases in which the forceps themselves play a rôle in the delivery; in other words, they should be used only in those cases in which the ordinary models have failed or given bad results. When we have bad results with forceps delivery, we usually blame the contracted pelvis or a marked disproportion.

With ordinary forceps, it is difficult to make a biparietal application especially when the head is not well engaged or when it fills the pelvis; it is necessary to make a pelvic application to the anterior and posterior diameter of the head and the blades come in contact with the forehead which cannot stand much pressure; the blades are separated and come in contact with soft parts and vaginal folds which are fixed and when an attempt is made to rotate, the soft parts are injured. Old forceps fail because they slip when biparietal application is attempted, and it is therefore impossible to rotate in these cases. During the application the anterior fontanel is pushed forward toward the symphysis because

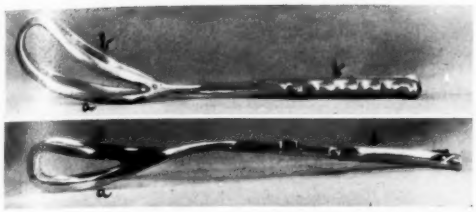

Fig. 1. Above, Elliott forceps; below, Kjelland forceps.

the blades do not grasp the head; when traction is made it therefore slips to the front. If one blade is applied to the posterior temple bone and the other to the occipital a good grip is obtained but delivery cannot be effected because the resistance of the frontal bone against the symphysis is too great.

A great many patients that have had difficult forceps deliveries with stillbirths come for subsequent examinations and antepartum care. To our surprise we find that most of them have had a normal pelvis or only a moderate degree of pelvic contraction, and there is no doubt but that the bad results were attributable to the faulty application of the forceps.

The construction of the Kjelland forceps is such that the blades can be applied more easily in transverse and oblique positions of the head. The points of difference between these and the ordinary models are the following:

1. The pelvic curve is less than in the ordinary blades making extraction easier and safer (Fig. 1, a).

2. The concavity of the pelvic curve is on a line with the handles of the blades (Fig. 1, b).

3. The lock-sliding arrangement permits accommodation (Fig. 2).

4. The connection between the blades and lock is longer than in other models, and is round and narrow so that the blades can easily be turned on the axis in utero. (Fig. 3, a).

5. The internal surfaces of the blades are convex, a cushion-like effect producing less pressure and cutting than the ordinary model (Fig. 3, b).

The application of these forceps has been successful in cases in which the ordinary forceps were difficult to handle or had failed; with the Kjelland it is possible to get the good grip necessary if the normal mechanism is to effect complete delivery with the least danger to the child. The points of the blades rests on the cheeks near the angle of the mouth and the blades embrace the biparietal protuberances; from the points of the blades the force is transmitted to that part of the head which can best withstand pressure.

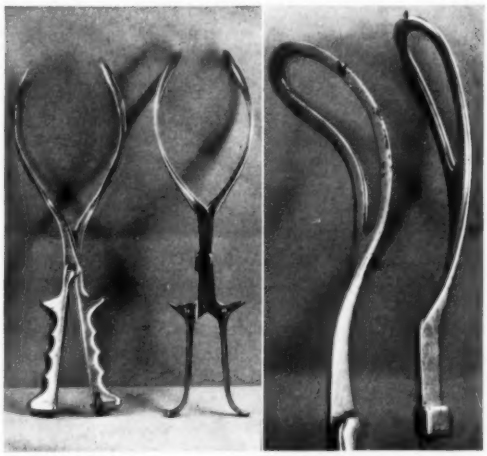

Fig. 2 (left). Another view of forceps shown in Figure 1.
Fig. 3. View showing the difference in the blades of the two forceps.

The pressure, however, is reduced to a minimum. With the ordinary forceps it is sometimes impossible to avoid having the blades grasp the neck and thereby cause compression, which is especially dangerous for the child if there is a loop of cord around the neck.

At first this method of application seems dangerous as compared with the ordinary methods, but this element of fear is soon eliminated when one convinces himself of the ease of introduction and extraction without any or very little resistance. However enthusiastic we become we must not forget that the Kjelland forceps have their limitations, as in the contracted pelves with rigid soft parts in old primiparæ.

RULES FOR APPLICATION

To make a biparietal application when the sagittal suture lies in the transverse diameter of the pelvis and the head is in the mid-plane

1. Have the patient in the lithotomy position on the edge of the table.

2. Before applying the forceps, be absolutely positive that your diagnosis is correct as to the situation of the head, the sagittal suture, and anterior and posterior fontantels.

3. Hold the forceps in the direction which you wish them to assume in the pelvis with the concavity of the pelvic curve toward the posterior fontanel. The blade which lies anteriorly is the one which should first be applied between the symphysis and the head. (One can also use the lock as a guide to point toward the position of the

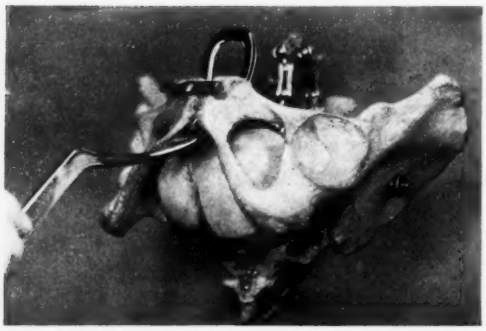

Fig. 4. Position of anterior blade. Concavity of fetal curve upward.

small fontanel.) Place two fingers of the hand under the anterior cervical lip; with the other hand grasp the handle of the blade; pass the forceps horizontally with the concavity of the fetal curve upward. Now pass the blade up against the head and the handle of the blade is lowered; pass it upward between the head and cervix under the symphysis (Fig. 4); this is done slowly and gently, as long as no resistance is met, until the middle round portion of the forceps rests in the postvaginal wall; rotate the blade on the head, rotate it toward the side to which the pelvic curves orginally pointed—that is, when the concavity of the forceps grasps the convexity of the fetal head, rotate about 90 degrees. In order not to become confused as to which side the concavity of the forceps lies on, after they are introduced note that on either side of the handle there is a small button (Fig. 2). Rotate this toward the side on which the button is situated.

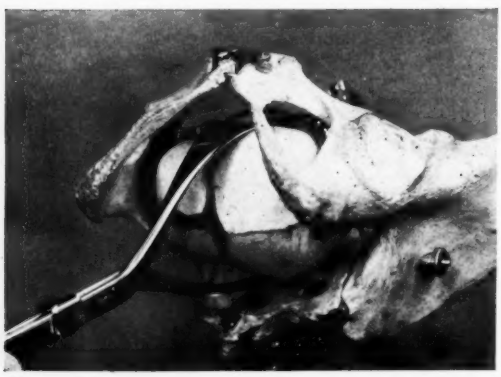

Fig. 6. Position of anterior blade after rotation of the anterior surface of fetal head. Application of posterior blade.

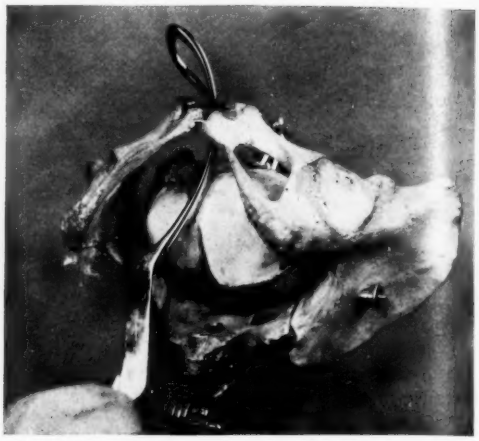

Fig. 5. Rotation of anterior blade.

After rotation the blade will slip up a little higher than at the time of introduction, if it was not originally introduced high enough. After rotation the lock lies against the postvaginal wall. No assistant is needed to hold this blade in position. The handle should rest in the center of the introitus unless the head is very high up.

The second blade is applied in the following manner: pass two fingers into the vagina to the posterior cervical lip; pass the second blade posteriorly on the side where the lock will approximate, and then introduce the blade gently to the side or in front of the promontory (Fig. 6). The blade usually meets no resistance unless the pelvis is contracted or the head impacted low down. In that event do not force the blade but gently manipulate it by lifting or lowering the handle of the blade. The lock is so constructed that it will approximate even if one blade is higher than the other. After the first attempt at traction both blades lock well. The forceps then lie in the anterior posterior diameter of the pelvis (Fig. 7). One can easily feel the direction of the handles. Do not use the symphysis as a pivot. You can now rotate the head if it is in mid-pelvis or you may make traction and rotate it nearly to the outlet. It is better to rotate first 90 degrees turning the sagittal suture from the transverse to the anterior posterior diameter. This rotation is performed without any traction, having the forceps well locked; then you make traction in the direction of the handles and the blades now lie in the transverse diameter of the pelvis (Fig. 8). As you approach the outlet it is not necessary to lift the handles to extract the head. When the

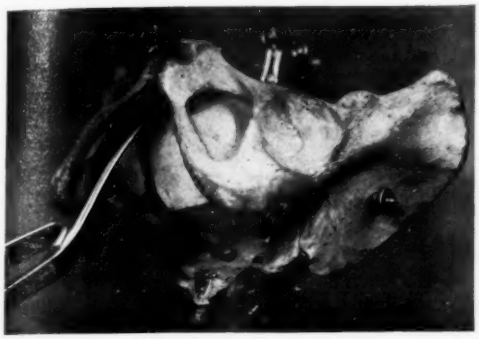

Fig. 7. Biparietal application with head in transverse diameter of pelvis.

head is in the occipitosacral position with the forehead anterior, you apply the blades in the same manner; the application then is only an oblique one on the fetal head and after slight traction the head accommodates itself in the transverse diameter of the pelvis. Finally proceed in same manner as just described. This method is called the inversion method. In cases in which the head is impacted low down in the transverse diameter of the pelvis, it is sometimes difficult to apply the anterior blade between symphysis and the fetal head. In that event it should be applied to the side opposite the small fontanel, as an ordinary cephalic application; then you glide the anterior blade adapting it to the side of the fetal head. The posterior blade is applied in the same manner as described above. This is called the gliding method.

The excellent results with the Kjelland forceps in mal-position of the vertex has already been reported by many authorities. Statistical reports show a low fetal mortality and very little injury to the fetal head. Bumm (Berlin) advocates very strongly the use of these forceps in occipito-posterior positions. In the Karmauner clinic in Vienna the forceps are strongly advocated not only in occipitoposterior positions but also in cases in which this complication occurs in a minor degree of contracted pelvis. They think that with the proper knowledge of the application of the forceps the prophylactic cæsarean may be abandoned.

Recently in the service of the Jewish Maternity Hospital and in my private practice we had wonderful success in the treatment of these cases with the Kjelland forceps. We collected about 100 cases in which we had most excellent, uniform results. In all the cases the mothers were discharged in good physical condition with no injuries to the bladder or perineum. Of course

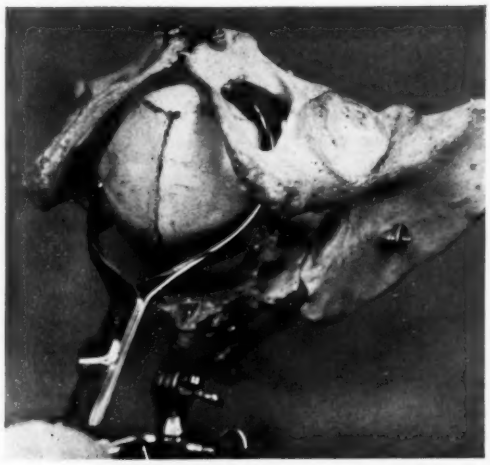

Fig. 8. Position of forceps after rotation.

prophylactic episiotomy was performed in nearly all the cases. There was no fetal mortality or injury except the ordinary marks of the blades which soon disappeared after delivery. While the number of cases in this report is small, we had some very difficult complications to deal with, and the outcome would not have been so successful with the ordinary forceps.

I will cite the following difficult cases:

CASE 1. A primipara, 24 years of age, was delivered by vertex presentation. Measurements in centimeters: interspinal, 26; intercristal, 28; right oblique, 26; left oblique, 26; external conjugate, 20; internal conjugate, 10; the outlet was roomy.

The onset of pains occurred July 25, 1923, at 6 o'clock a.m. The patient was admitted to the hospital July 26 at 4 o'clock a.m. Vaginal examination: external and internal os, 1 finger dilated. The canal was ¼ inch long, the membranes were ruptured, the head was at the inlet in left occipitotransverse position. At 10 a.m., with 2 fingers' dilatation, the membranes spontaneously ruptured, and the head was at the inlet; the fetal heart sounds were normal. At 2 p.m. ¼ grain of morphine was administered. At 4:30 p.m., with 4 plus fingers' dilatation and strong pains the head was engaged in left occipitotransverse position. At 8:30 p.m., the temperature was 102, pulse 92, respiration 34. At 9 p.m., ¼ grain morphine was given; the dilatation was 4 plus fingers and the position unchanged. At 10 p.m., the patient was admitted to the delivery room.

Indication for interference. The first stage had lasted 40 hours and was not complete. It was a dry labor. The temperature was 102; fetal heart, 170.

Treatment. A bilateral cervical incision was made with the sagittal suture lying transversely; Kjelland forceps (inversion method) were applied and the head rotated and extracted. A right lateral episiotomy was done. Profuse bleeding followed and the placenta was extracted manually. The uterus was packed, and a hypodermatoclysis administered.

Postpartum course. Temperature 100.8 and 102 on the fourth day, 101 on the fifth and sixth day, 100 on the seventh day, and was normal thereafter. The patient remained in the hospital 14 days, and was discharged in good condition. The cervical incision and the perineum healed. The weight of the child was 8 pounds 14 ounces.

CASE 2. A primipara, age 29 years, was delivered by vertex presentation, right occipito-anterior position. Measurements in centimeters: interspinal, 23; intercristal, 24 plus; right oblique, 25; left oblique, 25; external conjugate, 20. The promontory was not felt; the outlet was roomy. Labor was begun 11 o'clock p.m., August 26. Patient was admitted to hospital August 27, 1 o'clock a.m., because of strong contractions. Vaginal examination showed external os closed. At 9 a.m., the external os admitted 1 finger, internal os was obliterated; the membranes were intact. Morphine, ¼ grain, was administered. At 4 p.m., there was 1 finger's dilatation, thick cervix, membranes ruptured, head engaged, fetal heart normal. At 5 p.m., a hydrostatic bag (Voorhees) was introduced. August 28, at 6 o'clock a.m., the bag was expelled, the os was 4 plus fingers dilated, cervix thick, head engaged, right occipitoposterior position. At 2:40 p.m., the os was 5 fingers dilated, and meconium was passing. Delivery occurred at 3:10 p.m.

Indication for interference. Dry labor had lasted 40 hours and the first stage was not complete. The cervix was undilated. The meconium was passing, the death of the child impending, and the head was in right occipitoposterior position.

Treatment. A bilateral incision was made in the cervix; Kjelland forceps (inversion method) were applied with rotation and extraction. Postpartum course. On the third day the temperature was 103.8, pulse 126; fourth day, temperature, 98, pulse 101.6; on the thirteenth to sixteenth days both were normal. The patient remained in the hospital 17 days, and was discharged in good condition. The cervical incision healed by primary union. The weight of the child was 6 pounds 14 ounces.

CASE 3. A primipara, age 24 years, had a vertex presentation, left occipitoposterior position. Measurements in centimeters: interspinal, 23; intercristal, 26; right and left oblique, each, 27; external conjugate, 21; the promontory was not felt. Patient was admitted August 20, 1923, 6:30 o'clock p.m.

The onset of pains was August 18 at 1 o'clock p.m. On admission the external and internal os admit 1 finger; canal, 1 centimeter long; membranes intact; vertex at inlet. At 7 p.m., castor oil, 2 ounces, was given. At 12 p.m., os was 2 fingers dilated, cervix thin, membranes intact, left occipitoposterior position, pains strong.

August 21, 1:40 a.m., the os was 4 fingers dilated, and the membranes ruptured spontaneously. At 8 a.m., the os was 4 fingers dilated, the head engaged, fetal heart normal. At 8:30 a.m., morphine, ¼ grain, was given. At 4 p.m., the os was still 4 fingers dilated, and pituitrin, 3 minims, was given. At 5 p.m., no progress had been made.

Indications for interference. The first stage of labor had lasted 46 hours and was not complete; the patient was exhausted. It was a dry labor; left occipitoposterior position.

Treatment. A bilateral cervical incision was made and Kjelland forceps (inversion method) were applied with rotation and extraction. An episiotomy was done.

The postpartum course was normal. The patient remained in the hospital 10 days and was discharged in good condition. The cervical incision and perineum healed by primary union. The weight of the child was 7 pounds 5 ounces.

One can readily see that in these cases interference was imperative not only to save the life of the babies but also to terminate the exhaustive labors of the mothers. The ease with which the heads were rotated and extracted would thoroughly convince the obstetrician of the efficacy of this maneuver.

The technique in this maneuver is very simple. The necessary knowledge as to the direction of the fontanel and the proper placing of the sagittal sutures can certainly be easily acquired. The diagnosis is not always easy. However if there is any doubt, the whole hand should be inserted before an attempt is made to apply this maneuver. When it is impossible to make a diagnosis as to the position of the head the forceps should not be applied for failure will surely result.

ADVANTAGES

Before concluding I wish to review some of the advantages of these forceps over the ordinary forceps.

1. They are easy to apply in spite of the position of the head, and the direction of the sagittal sutures; no special experience in technique is required.

2. The position of the head is not altered by the application. This is an important fact, especially when there is slight pelvic contraction, in which case the ordinary forceps displace the head defeating nature's attempt.

3. It is necessary to introduce only two fingers instead of the whole hand as is sometimes necessary when the head is high up. This reduces the chances of infection.

4. The biparietal application does not permit the slipping of forceps. The point of the blades remains on the face near the chin and the blades run parallel with the long axis of the ovoid head and firmly grasp the head. The traction on the face is not only directed against the points but there is an even pressure of the entire instrument. There is no direct pressure over the eye, no pressure on the face, neck or facial nerve as with ordinary forceps.

5. Better rotation is obtained because the forceps can be applied in one position.

6. This application aids the normal mechanism in terminating labor.

7. Less force is required.

In conclusion, I wish to state that while these forceps have many advantages over the old, the range of indication should be no wider for them than for the ordinary blades.

PNEUMOPERITONEUM AS AN AID IN THE DIAGNOSIS OF OBSCURE PELVIC LESIONS AND EARLY PREGNANCY[1]

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Professor of Gynecology, School of Medicine, Vanderbilt University

INJECTION of air into the peritoneal cavity for diagnostic purposes was first carried out in Europe in 1902.

Weber, in 1912, working in the private institute for roentgen diagnosis of Doctors Eugene Weber and von Bergmann of Kiew, first conceived and carried out the idea of inflating the peritoneal cavity with air and then making a roentgenogram. He emphasized the importance of air and oxygen inflation of the abdominal cavity for experimental and diagnostic roentgenology and laid stress on the value of the method for obtaining good roentgenograms of the organs of the abdomen as well as for the roentgenographic representation of tumors and inflammatory swelling.

Dandy[2] in 1918 made the assertion that intestinal perforation could be diagnosed by the X-ray. The basis of this assertion was a case in the Johns Hopkins Hospital in which the diagnosis lay between a ruptured typhoid ulcer or a miliary tuberculosis with intestinal involvement. A roentgenogram of the lungs was made which fortunately included the upper part of the abdomen. The picture showed the liver widely separated from the diaphragm by a collection of gas. Operation revealed a gangrenous ruptured typhoid ulcer. Dandy stated that this roentgenogram gave him the idea of injecting air into the ventricles of the brain which he afterwards carried out. He injected air into the abdomen of dogs and suggested that it be used in the human being, evidently unaware at the time that it had been done in Europe a number of years before.

Stein and Stewart were the first in this country to inflate the peritoneal cavity with oxygen and then make a roentgen examination of the abdominal organs. Their paper published in the *Annals of Surgery* in July, 1919, gives a full history of the procedure and the technique that they used.

I. C. Rubin[3] of New York was the first to suggest and carry out the inflation of the fallopian tubes with oxygen to determine the patency and the production of an artificial pneumoperitoneum. His paper first gave to the profession an accurate and safe method of determining the patency of the tubes and furnishes a definite prognostic as well as diagnostic procedure in sterility of the female. Rubin has worked out a simple and safe technique, has perfected the apparatus for measuring the amount and rapidity of the flow of the gas, and called attention to the contra-indication.

Peterson in his articles on this subject gave many valuable suggestions toward developing the finer details of the technique. Rubin states, "Peterson had the happy thought of combining the transuterine with the transperitoneal method of producing artificial pneumoperitoneum and in his hands the method has become established as a valuable adjunct in gynecological diagnosis."

Pneumoperitoneum has been used with safety in a large series of cases in a number of clinics in this country, without any untoward accidents. There are, however, certain contra-indications that should be remembered, otherwise pneumoperitoneum may result in serious consequences to the patient. I have discovered that it can be made almost painless by a postural method which will be described later in the paper. It is a procedure that is only indicated in cases in which the diagnosis is obscure. A diagnosis should not be arrived at until the history, the physical signs, the vaginal examination, and the pneumoperitoneum roentgenogram are considered as a whole.

McClure and I have been able to make out in the pregnancy cases a much thickened uterine wall with a distinct cavity and in this cavity a mass which we believe is a pathognomonic sign. Our series of cases is not sufficiently large to be absolutely positive. We trust, however, that our technique will be tried out in other clinics and this sign be either confirmed or disproved. So far we have not found any other condition that will show this picture, not even large submucous fibroids.

In the study of sterility it is the only accurate method of determining the patency of the tubes and when these are occluded operations on the cervix are useless and other procedures meeting the demands of the case should be carried out. Peterson found that in a series of 36 sterile women 13 or a little over ⅓ conceived after inflation and that 10 of these went to full term, the other 3 aborting. It is also of great value in that class of cases that present marked pelvic symptoms but the roentgenogram shows a normal uterus, tubes,

[2] Ann. Surg., 1918, July.
[3] J. Am. M. Ass., 1920, September.

[1] Read before the Southern Surgical Association in Charleston, South Carolina, December 9, 1924.

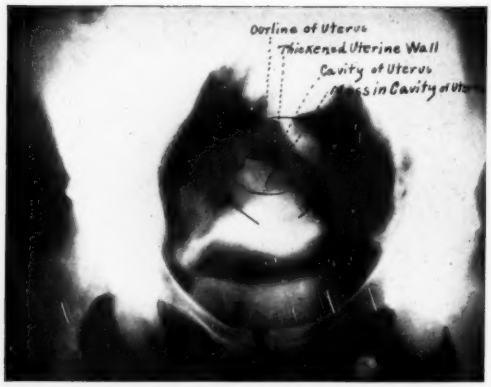


Fig. 1. Pneumoperitoneum, 3½ weeks' pregnancy.

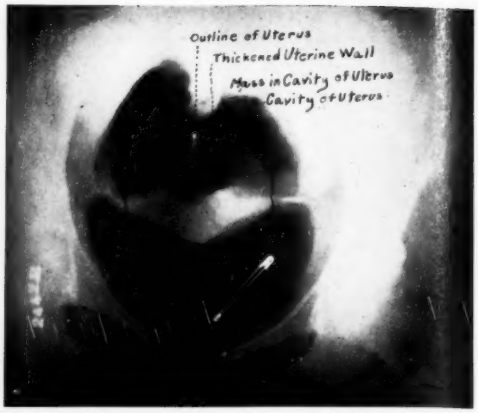


Fig. 2. Pneumoperitoneum showing 6 weeks' pregnancy.

and ovaries. It renders these poor neurasthenics much more hopeful and paves the way for the neurologist to make a permanent cure.

McClure suggests the following regarding the making of the roentgenogram:

There are three important points in the X-ray examination of the uterus, tubes, and ovaries by the pneumoperitoneum method, which are necessary in coming to an opinion worth while.

1. All plates are made stereoscopically.

2. The examination is made by use of the Bucky diaphragm.

3. The position of the patient and direction of the rays must be such that no portion of the sacrum overshadows any of the pelvic viscera. Stereoscopic plates are used because with them the examiner can determine the relation of a mass shadow to the normal pelvic organs. The Bucky diaphragm is used because it is the only method at our command that gives marked contrast.

The position of the patient is face down on the Bucky, with head lowered until the table reaches an angle of about 30 degrees. The rays are directed straight down at a point just below the tip of the coccyx. This causes the entire shadow of the sacrum to be thrown well above the outline of the brim of the pelvis.

Our technique with the Bucky diaphragm, is as follows:

A 4½ to 6 inch back up is used, depending on size of the patient, with 40 milliamperes, 5 seconds, always at a distance of 25 inches.

Carbon dioxide is now used instead of oxygen for making the inflation of the peritoneum. It is rapidly absorbed and for this reason the procedure must be carried out in the X-ray room.

The preparation of the patient is quite simple. Liquid diet is given the night before, with no breakfast the morning of the inflation. An enema is given the night before and repeated in the morning. If the peritoneum is to be inflated by the uterine route a douche should be ordered a.m. and p.m. in order to remove any excessive secretion from the vagina.

The necessary apparatus is a tank of carbon dioxide which may be obtained at any soft drink stand, a reducing gauge for the tank, a Rubin's siphonmeter attached to a mercurial manometer, a spinal puncture needle for puncture, inflation of the abdomen, and a Keyes Ultzman cannula perforated at the tip by several small apertures for the introduction of gas into the uterus for testing the patency of the fallopian tubes and providing a pneumoperitoneum by this route. A rubber stopper or washer perforated should be fitted on the Keyes Ultzman cannula to prevent the back flow of gas from the cervix.

For inflation by way of the uterus I place the patient in the knee-chest posture. All instruments are sterilized and the operator and his assistant wear gloves. The posterior vaginal wall is retracted with a Sims speculum, the cervix is exposed and painted with iodine or picric acid solution 5 per cent and is then brought down to the vaginal outlet with Volsellum forceps. A uterine sound is then introduced into the uterus to determine the direction and depth of the organ. The Keyes Ultzman cannula is then inserted and connected to the tube leading from the gas tank and the gas is turned on. The rate of the flow of the gas and the amount are determined by the siphonmeter. Each pulsation of this instrument shows

that 60 cubic centimeters of gas is displacing the water in the vacuum. There should be four pulsations to the minute or the passage of 240 cubic centimeters of carbon dioxide in this period of time. The amount introduced depends on the size of the abdomen and therefore it ranges from 600 to 1,200 cubic centimeters of gas. The mercurial manometer should be carefully watched. If the tubes are open it will run from 60 to 100 and as the gas begins to flow in the abdomen it will begin to drop and will then go up and down between 20 and 80. If it should go as high as 200 the cannula should be slightly withdrawn in order that the gas may escape through the cervix. A pressure of 200 signifies that the tubes are closed and it is not safe to use a higher pressure to inflate them. Before stating positively that the tubes are closed 12 attempts at one sitting with the manometer going to 200 should be carried out. After the patency of the tubes is established the gas is allowed to flow until enough is introduced for a good roentgenogram. The picture is made at once with the patient lying on the Bucky diaphragm in the Trendelenberg posture.

I have discovered that the method can be made almost painless by keeping them in this posture for 15 minutes following inflation by either the uterine or the abdominal route. The reason for this is easily understood; the gas naturally goes to the highest part of the peritoneal cavity, which is the pelvis in either of these positions and in 15 minutes it is absorbed and the severe pain caused by the gas separating the liver from the diaphragm, which would occur if the patient were allowed to get in the recumbent posture immediately following inflation, is obviated.

For abdominal inflation the same technique is essential as for the uterine. The patient is placed in the Trendelenberg posture, the abdomen at the site of the puncture, which is 1½ inches below the umbilicus in the median line, is cleansed with benzine-iodine and alcohol. The puncture is rendered painless by first injecting the skin and then the deeper parts with one-half of one per cent solution of novocain. A spinal puncture needle is used; first it is pushed through the skin to the fascia which is easily recognized by the resistance, and then at the next thrust it will pass into the peritoneal cavity. One naturally thinks that a coil of intestine may be perforated if the puncture is not very carefully made. I have made many punctures during operations with the abdomen open and I can emphatically state that it is almost an impossibility even to bruise the intestine, much less penetrate it. If there is scar in the median line from a former abdominal section, then of course the puncture should be made at some other site, but this makes no difference except the peritoneal cavity is a little further away than at the site of election. After the cavity is inflated the patient is turned on the stomach but still kept in the Trendelenberg posture and the picture is made. After resting 15 minutes in this posture the patient is allowed to get up, eat a full meal, if they so desire, and walk out.

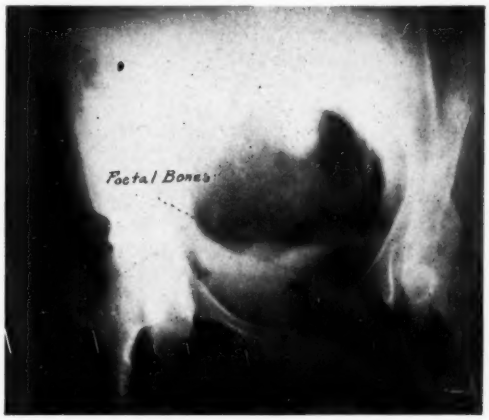


Fig. 3. Pneumoperitoneum showing fetal bones 3 weeks before appearance of fetal heart sounds.

There are certain contra-indications that must be carefully observed. The tubes should not be inflated when there is an acute pelvic inflammation nor should inflation be tried when there is a bloody or purulent discharge from the uterus. Under such conditions the transabdominal method should be used. The peritoneal cavity should not be inflated by either method in patients with large uterine or abdominal tumors or serious circulatory changes. In such conditions a fatal result might be brought about by a sudden rearrangement of the abdominal organs and the upward pressure of the diaphragm with a badly acting or diseased heart.

Large tumors do not make as good roentgenograms as small ones, for the reason that these tumors fill the pelvis and do not give the gas an opportunity to get in this region. Fortunately a diagnosis can usually be made in this class of cases without a roentgenogram.

It is possible in the pregnancy cases that have advanced sufficiently far, to make out the fetal bones on the roentgenogram several weeks before the fetal heart can be heard. This depends on the time that the calcification of the fetal bones takes place and this varies in individual cases.

CONCLUSIONS

I feel that the following conclusions are warranted and conservative:

1. Inflation of the peritoneum by either the abdominal or uterine route is perfectly safe in cases in which there are no contra-indications.

2. There is very little pain if the patient is kept in the knee-chest or Trendelenberg posture during the inflation and for 15 minutes after it.

3. The method is of the greatest aid in obscure pelvic cases and will make an accurate diagnosis possible.

4. It is possible to diagnose with certainty pregnancy in the early weeks, provided the pathognomonic sign mentioned in the paper is shown in the roentgenogram.

I desire to express my deep appreciation to Dr. Reuben Peterson of Ann Arbor, Michigan, for demonstrating to me his technique and for his courtesy to my X-ray associate, Dr. C. C. McClure, in permitting him to make an extensive study of all of his pneumoperitoneum plates in the University Hospital at Ann Arbor. I also wish to thank Dr. I. C. Rubin of New York for having his instrument maker forward me his siphonmeter in order that I might take up this work.

CLOSING ENDOMETRIUM IN CÆSAREAN SECTION

By OLIVER C. COX, M.D., Washington

RUPTURE of the uterus during subsequent pregnancies, and intestinal obstruction at any time from 1 week to 23 years after, are the real dangers of cæsarean section. Probably infection plays a part in causing these unfortunate occurrences. With modern operating room technique and with patients who have not been subjected to vaginal examination, there should be a minimum of infection. However, the reports of these two disasters are increasing constantly in number.

It can be understood readily how it is difficult to hold with sutures a wound in a muscular organ that is alternately contracting and relaxing. Particularly is this true in the puerperal uterus; because, during involution there is rapid and marked diminution in the size of the whole muscular structure. This is by some process not exactly understood; and it is plausible that this very process of involution impedes healing of the muscle fibers. If aseptic technique is carried out perfectly and yet we have rupture of the uterus, must we not look for some other fault?

Let us examine the method of suturing. In descriptions of the classic cæsarean section, the sutures are placed in the myometrium and peritoneum. It is always stressed not to sew the endometrium. The reasons for not sewing the endometrium are not good, but there are many excellent reasons for sewing it. No other epithelial lined organ is closed without the mucosa first being sewed. Then, why not close the uterine mucosa with a continuous fine chromic suture? Then the wound through the uterine musculature can be wiped clean and closed without blood entering it from the interior of the uterus. It is well known that a few days after labor, all uteri harbor bacteria. If the mucosa is closed accurately, it will heal tightly in a few hours, thus protecting the sutured muscle. When the mucosa is not closed and the uterus is sutured in the usual manner, there is an eversion of the edges of the mucosa. The muscular fibers of the line of suture are brought into contact with the bacteria ladened lochia. Consequently, a thin scar of fibrous tissue and peritoneum is the result. Interrupted stitches leave too many knots in the wound. Knots are slow to be absorbed, cause serum to collect around them, and are likely to be extruded into the uterine cavity.

I have used the following method of closure in several cæsarean sections, and believe it to be superior to the methods described in most texts:

1. The mucosa is closed with a continuous No. 1 chromic catgut.

2. The uterine muscle is closed with two layers of continuous No. 2 chromic catgut, very deep bites into the muscle being taken.

3. The peritoneum is closed with No. 0 chromic catgut and the Lembert stitch is used in making the suture.

Thus the muscle layer is sealed between sutured mucosa and sutured serosa.

A MODIFIED MAYO UMBILICAL HERNIOTOMY

By C. A. ROEDER, M.D., F.A.C.S., Omaha, Nebraska

SINCE W. J. Mayo[1] first described his operation for umbilical hernia in 1898, it has been adopted by the vast majority of surgeons because of its simplicity and universal success. The operation is based upon a proper conception of the regional anatomy and physics of the abdominal wall. In this operation the umbilicus is sacrificed and the transverse opening through the abdominal wall closed by an overlapping of the incision. A modification of this most satisfactory operation is offered because of requests from patients who preferred not to lose the umbilicus if possible. Two mothers of girls of 8 and 10 years respectively refused to have the operations performed if the umbilicus was to be removed, and a

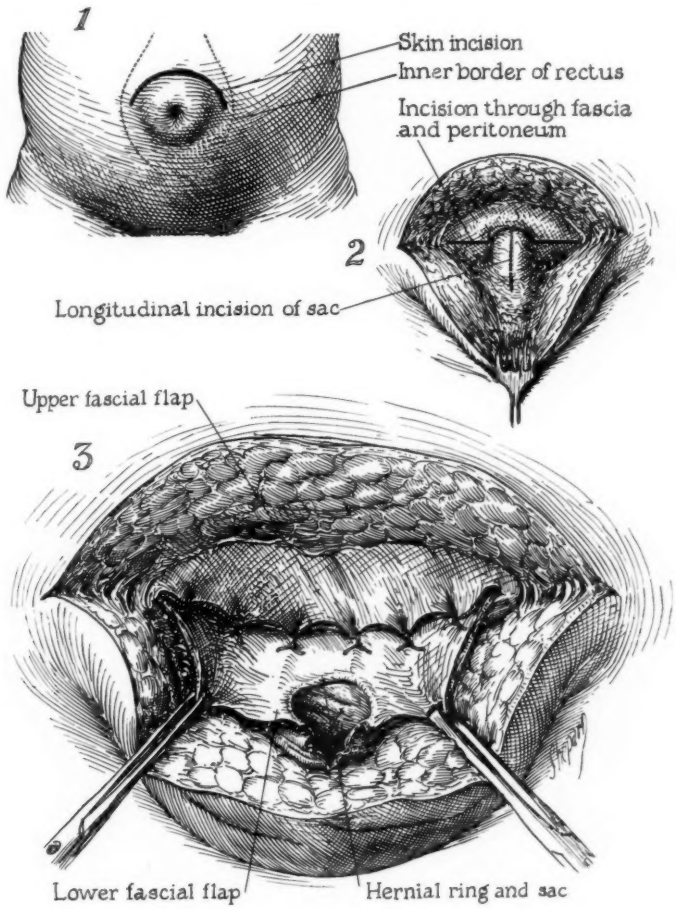


Fig. 1.

[1] Mayo, W. J. Ann. Surg, 1899.

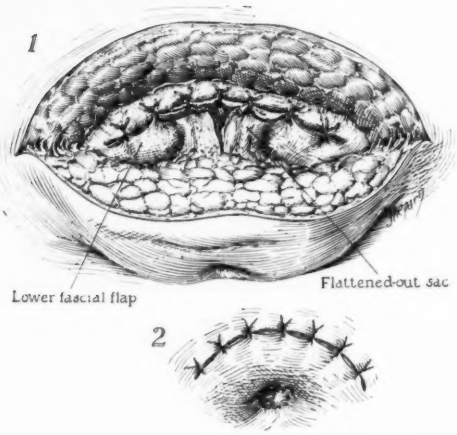


Fig. 2.

man returned to me 1 year after a successful Mayo umbilical herniotomy stating that he regretted the loss of his umbilicus, because as physical instructor in a gymnasium, he had been subjected to the scrutiny and joking of the patrons.

This abdominal dimple, when looked at æsthetically, may not be without some decorative value; and its loss, however negligible from a practical standpoint, is a constant reminder to certain types of sensitive individuals, particularly if they are exposed in gymnasiums, bath houses, etc. These experiences led me to endeavor to modify the Mayo operation and to apply the modification whenever practicable, particularly in young patients and in adults with small herniæ. If the umbilical hernia is very large and has destroyed the outline of the umbilicus, and the abdominal wall is very fat, my operation is useless and unsatisfactory.

TECHNIQUE

The illustrations describe the operation. Only one-half the usual area of fascia is denuded of fat. This lessens the occurrence of postoperative fat emboli proportionately. For a varying length of time following the operation there is a palpable mass just beneath the remaining umbilicus which has been mistaken by examining physicians for a recurrence. This mass is the result of doubling of the abdominal layers which protrude the umbilicus just enough so that it is mistaken for a recurring hernia. This disappears in due time, however, leaving the region around the umbilicus with a normal appearance. I have performed this operation 8 times in the past 5 years with no recurrence to my knowledge.

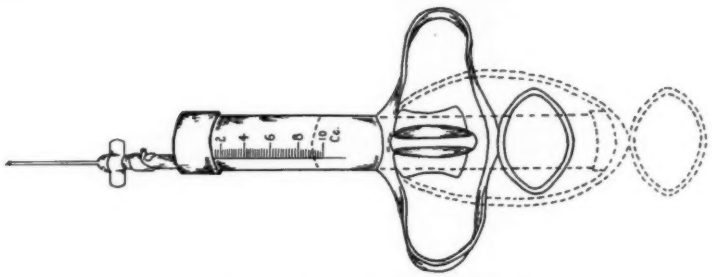
A SIMPLE METHOD OF CONNECTING A GLASS SYRINGE AND PLUNGER

By ROBERT EMMETT FARR, M.D., F.A.C.S., Minneapolis, Minnesota

ONE of the most frequent causes of breaking the barrel of plunger of a glass syringe is the dropping of one of them while the other is held in the hand. If one grasps the plunger only, the barrel is likely to slip off and be broken; likewise if one grasps the barrel the plunger may fall out and meet with disaster. Many syringes of this type are supplied with a small chain which serves the purpose of preventing these accidents. There are, however, many all-glass syringes in use to which the safety chain is not applied. The chain is easily broken or detached and not so easily replaced and many of them are unsatisfactory.

The device here illustrated may be adapted to any syringe, it really improves the opportunity for handling the syringe deftly, and its expense is nil. If it is broken, detached, or mislaid it may be replaced without inconvenience.

It consists of a simple rubber band of appropriate width and length. Its length should correspond approximately to the length of the syringe. When the syringe is filled to capacity (see figure), the rubber band will effectually prevent the plunger from slipping out of the barrel. If, however, one wishes to withdraw the plunger for the purpose of cleansing or sterilizing, the elasticity of the rubber band readily permits such withdrawal.



The dotted lines indicate full extension of instrument.

Rubber bands of the desired dimensions may be procured at any stationery supply house. In order to prepare the band two short slits are made with the scissors at points exactly opposite and the barrel of the syringe is forced through one of them, the plunger through the other.

SUBMUCOSA DISSECTOR

By A. J. GRAHAM, M.D., Chicago

THIS instrument was devised to do exact dissection in those instances in which habit has led the operator to use the end of the scalpel handle or scissors, which instruments, obviously, are not uniform in size, shape, or degree of sharpness.

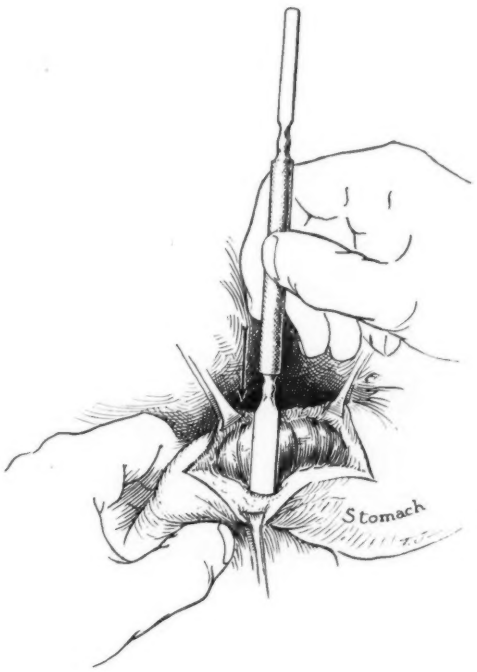
Point *A* (small end) is for use in splitting the bowel wall.

The cleavage in this instance takes place in the loosest part of the submucosa just against the circular muscular layer, as here also occurs "the sliding of coats" in protrusion of the mucous membrane, when the bowel is sectioned. Point *A* is designed to break these layers apart without cutting and thus causes the least hæmorrhage (congenital pyloric stenosis, enterostomy).

Other uses of the instrument: It may be used to lift the peritoneum from any structure, as in exposing the gall-ducts, or ureter, or in separating adhesions.

Point *B* (large end) is beveled and the long edge, properly dulled, is directed against the leather-like submucosa and thus scrapes it clean. Instances of this use are (1) the shoving off of the pyloric sphincter muscle in congenital pyloric stenosis; (2) the clearing of the gall bladder or liver and connective tissue in cholecystectomy; and (3) the separation of the peritoneum and bladder from the uterus when directed against the uterine muscle in hysterectomy.

Note.—These instruments are inspected before distribution to insure the proper degree of dulness, so that they will *scrape*, but not cut the tissues. (See "Isolation of Submucosa in Intestinal Surgery," Surg., Gynec. & Obst., xxxviii, 259.)



FLEXO-EXTENSOMETER

By H. EARLE CONWELL, M.D., Fairfield, Alabama
Assistant Chief, Surgical Clinic, Tennessee Coal, Iron and Railroad Company, Employees' Hospital

THE usual method of outlining the ankylosis of a joint with pencil and paper is not only a slow and tedious one, but seldom accurate, because the least change in the angle of the pencil will cause errors. Accuracy in the determination of degrees of ankylosis in the joint, and the progress of motion, flexion, or extension, is very important.

To get absolute record on such cases, I have found that the instrument which I devised, as described here, is most efficient. It requires only a few seconds to make the determination with the flexo-extensometer, and the absolute degrees of flexion and extension are given. When this record is made at every visit, the doctor and patient have a concise and accurate history of the progress. In the severe cases of ankylosis, patients should be allowed to use this instrument frequently during the day.

The outfit (Fig. 1) consists of three sets of nickel plated spring metal clasps of different sizes, with thumb screws, and two nickel plated metal handles and one nickel plated metal dial, the latter forming one-half circle (180 degrees). The handles are joined at the center of the diam-

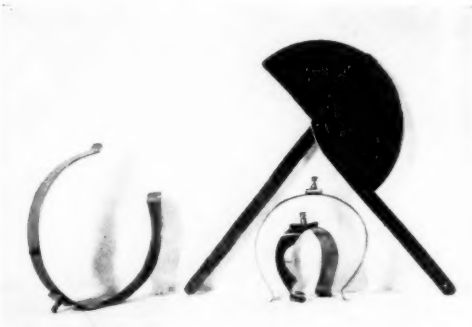


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

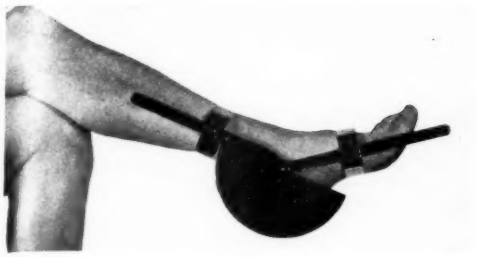


Fig. 5.

eter of the dial, one handle having a pointer indicating the degrees of motion, and the other being attached to the dial. On the dial the degrees are numbered from 0 to 90, right and left from the center.

Therefore, when the pointer stands at zero, the joint is at right angles. Estimation of motion is made as so many degrees flexion, extension, or fixation from a right angle.

The device can be used on the elbows, wrists, knees, or ankles, right or left, and on internal or external surfaces (Figs. 2, 3, 4, 5, and 6). When the estimation is being made, the junction of the

Fig. 6.

two handles should always rest on the condyles of the humerus, or femur, on the styloid processes of the radius or ulna, or on the malleoli of the ankle. The clasps are easily adjusted to the limbs and held at any place along the handle with the aid of thumb screws.

MEMOIRS

THOMAS J. WATKINS, M.D., F.A.C.S.

IT is with the deepest regret that the Editorial Board announces the death on April 1, 1925, of Dr. Thomas J. Watkins, one of the founders of SURGERY, GYNECOLOGY AND OBSTETRICS and a member of its editorial board from the beginning. Apparently in perfect health he was dictating letters at his office when struck down. His death came from what was probably a cardiac angina.

Born near Utica, New York, in 1863, this master plastic surgeon spent his boyhood in hard manual labor upon the farm. Denied such holiday pleasures as fall to the lot of the average country youth his earlier years of life were devoted to unceasing daily toil and drudgery, relieved, when possible, by winter months of study at a country school. Subsequently, after hard-earned preparatory education at Holland Patent Academy and Adams Collegiate Institute, he borrowed funds sufficient to defray the expenses of 3 years' work at the University of Michigan. A medical degree was thereafter obtained at Bellevue Hospital Medical School, this, in turn, being followed by interneships in the Utica (N. Y.) City Hospital, St. Peter's Hospital of Brooklyn, and the Woman's Hospital in the State of New York. In the Woman's Hospital he obtained valuable training under the direction of the late Thomas Addis Emmet.

In 1889 Dr. Watkins moved to Chicago and in 1892 was married to Catherine Carman of Poughkeepsie, New York. He joined the staff of Northwestern University Medical School at an early date, and at the time of his death was chief of the department of gynecology in that institution. Numbered among his many pupils are several who have attained eminence in the surgical world.

Dr. Watkins was a master of gynecological technique and possessed unequaled skill in the art of plastic surgery. He was perhaps best known as the orginator of the procedure which he termed the "transposition" operation, popularly called by others the "Watkins" or "Watkins-Wertheim" operation for cystocele and uterine prolapse. Elected to the American Gynecological Society in 1896 he was honored with the presidency of that society in 1915, and was the recipient of many other honors. He was a founder of the American College of Surgeons.

Although it is impossible to portray, adequately, the beautiful character of this gentle man who yesterday was in our midst, that which has been thus far said would be but mockery without some added words. He spent a life of labor and unselfishness. He gave freely of himself and of his earnings to every cause which merited. He was generous in praise of others, modest in demeanor, always gentle, kindly, true—a manly man who will be sorely missed. ARTHUR H. CURTIS.

THOMAS J. WATKINS, M.D., F.A.C.S.

1863-1925

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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WILLIAM J. MAYO, M.D.....Chief of Editorial Staff

MAY, 1925

CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS

THE American Medical Association was organized in May, 1846, with Nathaniel Chapman, of Pennsylvania, as president. The first meeting of the association which I attended was held in St. Paul in 1882, when I was a medical student; since then I have missed very few of the annual meetings.

At the meeting in St. Paul, Dr. J. L. Atlee, of Lancaster, Pennsylvania, was elected president. In acknowledging this distinction, Dr. Atlee said that he considered the great honor which had come to him in the presidency of the American Medical Association as a delayed recognition of the service his brother had rendered to surgery. Washington L. Atlee, the elder brother, was the great leader in ovariotomy in this country, following the pioneer, Ephraim McDowell, who performed the first ovariotomy in a farm home in the Kentucky mountains. My father was stimulated by the work of the Doctors Atlee, and he performed ovariotomy in about fifty cases in the early days.

In the eighties there developed a great schism in the American Medical Association. The Medical Society of the State of New York admitted homeopaths to membership, which led to the expulsion of this organization from the American Medical Assocation. A second state society was formed, leading to a bitter local feud, which lasted twenty years before the breach was healed.

In the early years of the American Medical Association, its conventions were carried on like ordinary town meetings or gatherings of county medical societies. There were no sections, the papers being read in general session, and much time was given to medical politics. The American Medical Association was the representative medical organization in the period when it was possible for one man to know much of what was available in medical science. My father and men of his generation stood relatively much higher in all branches of known medicine in their day than it is possible for a man to stand in any one of the specialties now.

Gradually it became recognized that men who were engaged in special work, particularly teachers, should have a means of exchanging views for the purpose of making progress, and, to effect this, sections were established in the American Medical Association. The constant turmoil of medical politics interrupted the work, and the sections were at first only moderately successful.

The great leader at this time was Nathan S. Davis, of Chicago. It was because of his good sense and leadership that the American Medical Association finally came to represent the entire profession. Davis, in 1901, proposed the establishment of a House of Delegates on the basis of representation, which was effected

in 1902. Within a few years the House of Delegates was well established in its present form. It has done and is doing for the medical profession a great work, for which it receives too little credit.

The Congress of American Physicians and Surgeons had its inception in 1886. National societies devoted to the specialties in medicine and surgery had been developed previously: the American Ophthalmological Society as early as 1864, the American Otological Society in 1868, the American Neurological Association in 1875. The American Surgical Association was organized in 1880 by Samuel D. Gross and other men of comparable attainments, of whom William W. Keen is the sole survivor. These special societies were followed in the course of a few years by various others. Each held its regular meetings at times suited to itself. There was no interrelation among the organizations, and each was uninformed as to the work the others were doing. It was realized by such men as Claudius H. Mastin, of Mobile, Alabama, and W. H. Carmalt, professor of surgery at Yale, that the existing routine of the special societies had a tendency to narrow the outlook of the Fellows. The human body is not like a machine, the parts of which may be distributed to different workmen for repair, with satisfactory results. It seemed advisable that the special societies should meet jointly at convenient intervals for open discussion of subjects interesting to all, to develop a broader outlook.

An organization of the national special societies for this purpose was proposed by Dr. Mastin in 1886, during his presidency of the American Surgical Association, at the seventh annual meeting, to be called "The Congress of American Physicians and Surgeons." It was determined that the Congress should in no way detract from the value of the American Medical Association, but that it should devote its attention to highly specialized branches of medicine.

In 1887 the Congress of American Physicians and Surgeons was organized, and met for the first time in Washington, D. C., in September, 1888, under the presidency of Dr. John S. Billings, of Washington. The organization included the eleven oldest special national medical societies: the American Ophthalmological Society, the American Otological Society, the American Neurological Association, the American Gynecological Society, the American Dermatological Association, the American Laryngological Association, the American Surgical Association, the American Climatological and Clinical Association, the Association of American Physicians, the Association of Genito-Urinary Surgeons, and the American Orthopedic Association. The joint meetings of the societies thus banded, the Congress of American Physicians and Surgeons, were to be held once every three years in Washington, D. C.; no society was to be admitted except on the unanimous vote of the Executive Committee, which was composed of one delegate from each society. A number of special societies have been admitted since the organization of the Congress.

May 5 and 6 of this year, the thirty-seventh year of the organization, the thirteenth convocation of the Congress of American Physicians and Surgeons is to be held in Washington. The program for each meeting has been carried out as planned originally. The subject for discussion this year will be "The Ductless Glands," to which contributions will be made by the various special societies, either in papers or in set discussions which will take up one afternoon and evening of the meeting. The remaining time will be taken up by separate meetings of the constituent societies for the transaction of their special work, which will occupy three days: May 4, 5, and 6.

The Congress of American Physicians and Surgeons has a great function to perform in coordinating and sanctioning the best of the vast amount of new knowledge so constantly being presented to the medical profession.

WILLIAM J. MAYO.

THE TREATMENT OF ADOLESCENT GOITER

THERE is nothing more to be deplored than the surgical operation performed unnecessarily. It is, of course, a well known fact that operations, for which there are no actual indications, are being performed daily, operations which do nothing beyond withdrawing something from the patient's store of health, a store which is often small enough.

As each new disease becomes better understood, it becomes the subject of exploitation at the hands of all the cultists in turn, and, unfortunately, often at the hands of the regular physician, particularly the specialist whose enthusiasm, rather than lack of conscience, occasionally leads him far afield from the realm of rational therapeutics. Thus the honors have been borne respectively by the ptosed stomach, movable kidney, incompetent ileocæcal valve, retroverted uterus, chronic appendix, atonic colon, and each of a multiplicity of other pathological vagaries even more spurious.

With the recent interest aroused in the medical profession over the subject of endocrinology ("endocriminalology" — Marine) there has been an extraordinary development of our knowledge of the physiology and pathology of the ductless glands, especially of the thyroid, with, as with all new and especially complex questions, a corresponding extraordinary distortion of the actual facts and, in some quarters, with a hopelessly imperfect understanding of the subject.

A lack of unanimity of opinion regarding the treatment of toxic goiter is not perhaps to be wondered at; but with the results of the tireless researches of such workers as Plummer, Marine, C. H. Mayo, and Crile at our disposal, it would seem that there should be a more perfect crystallization of opinion as to the treatment of the colloid type of adolescence.

Such a lack of unanimity apparently does exist, the most unfortunate result of which is the lamentable vogue, now at its peak, of thyroidectomizing every young girl who possesses a colloid goiter. The surgeon who routinely advises thyroidectomy in cases of this type, and such advice is being given daily, would do well to pause until he has a firmer grasp of the subject of the thyroid and its physiology. Rarely, and then only when adenomata are found, or the gland is very large and has not been reduced by less formidable means, or is accompanied by toxic symptoms, should these girls become the patients of the surgeon. To remove the usual, adolescent, colloid thyroid—after all it is a mistake to call them "goiters"—merely because it is hypertrophied, is as illogical as it would be to excise a lactating breast because it is enlarged.

There are many sections of our country where the iodine content of the water supply is especially low; in these sections over 30 per cent of the adolescent girls present a smooth, symmetrical enlargement of the thyroid. In such sections there has been an appalling number of thyroidectomies, operations which do not aid the patient, but which subject her to needless surgery with its accompanying hospitalization, and, which in many instances, change her from a comparatively normal girl to a chronic sufferer from the effects of thyroid insufficiency.

The brilliant results obtained by the pioneers, Marine and Kimball, following the administration of iodine in goiter prophylaxis, have not, unfortunately, been paralleled in the

treatment of adolescent goiter; but failure to cure colloid goiter by the administration of iodine or thyroxin does not, by any means, indicate surgical excision. Better far to do nothing than to remove a highly important and essential gland merely because it is enlarged and happens to be near the surface of the body. One speculates as to what would be the fate of the adrenals, the thymus, and the pineal were they more accessible.

The thyroid of a developing girl can not be resected with the same impunity as is the case in the removal of her appendix, the dilatation of her uterus, or the shortening of her round ligaments. In the long run such procedures, performed often on questionable indications, may produce no great harm even if, in the given instance, they accomplish no good. This situation does not, however, apply to resection of the thyroid gland.

The prominence given in the past few years to the subject of toxic goiter, the great prevalence of neurocirculatory conditions especially in girls at the stage of adolescence, the frequent occurrence of a slight degree of thyroid enlargement in such individuals, and, to a certain extent, the recent throwing upon the market of certain cheap and often highly unreliable apparatus for the alleged determination of basal metabolic rates, have all combined to make the diagnosis of "hyperthyroidism" in the case of the adolescent colloid far too common.

That the surgeon should always feel that he will actually help his patient when he operates upon her is, of course, a simple academic proposition. It should, however, be carried beyond this; for with very few exceptions, the surgeon should be able to give his patient most positive assurance that she will be cured or at least most positively and definitely benefited—an aphorism which we should keep more carefully in mind when dealing with adolescent goiter.

HAROLD L. FOSS.

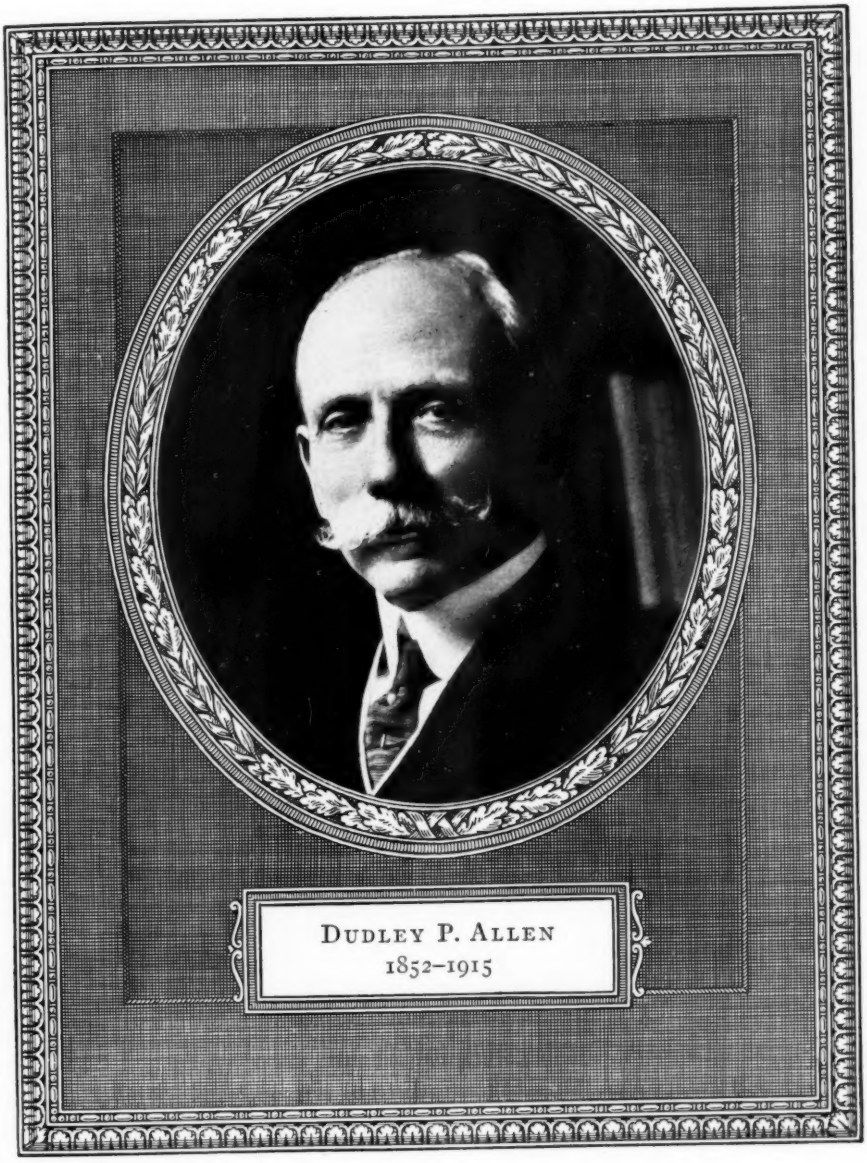
MASTER SURGEONS OF AMERICA

DUDLEY PETER ALLEN

MEN who achieve distinction achieve it along widely diverse paths. Some as a result of a single stroke of genius scale the heights of fame. Others as the result of long years of effort along one or a few closely related lines, make discoveries of great significance in their chosen fields. Still others, as the result of unusual versatility are able to place the impress of their personalities upon diverse fields achieving distinction in each.

In this last group should be placed Dudley Peter Allen, who was at once a surgeon whose abilities as such brought to him the recognition of his fellows as expressed in his election as president of the Ohio State Medical Association and of the American Surgical Association and his appointment as an honorary fellow of the Philadelphia Academy of Surgery and of the American College of Surgeons; a connoisseur of the arts, whose unusual knowledge of the graphic arts in particular has been memorialized in the Cleveland Museum of Art and in the beautiful Museum in Oberlin which bears his name; a literateur with a specialized knowledge of the literature pertaining to his chosen profession, a knowledge which found its chief expression in the Cleveland Medical Library and will be memorialized by the new building which is to bear his name; and an organizer, as evidenced repeatedly throughout the long period of his connection with the Medical School of Western Reserve University and with Lakeside Hospital.

Dudley Peter Allen was born in Kinsman, at the original family homestead in the Western Reserve, on March 25, 1852, but his youth was spent in the town of Oberlin, where he passed through Oberlin College in his preparation for the profession, which we may assume was chosen more or less as a matter of course because of the family background. We are told by those who knew him well that in his undergraduate days he was not especially studious and showed no particular interest in his work except for a love of literature engendered by seasons of ill health. At Harvard, however, the importance of application and of studiousness appeared first to be awakened in him and he soon became a man of mark among his classmates. Even during his student days, the versatility which was his outstanding characteristic was evidenced and while pursuing his medical studies he was already making a special study of the history of art and beginning a collection of etchings and engravings.



DUDLEY P. ALLEN
1852–1915

Just what led him to be a surgeon rather than an internist I do not know, but it seems to have been an unswerving determination, one from which he never wavered. It is possible that in addition to the opportunities for study in the great surgical clinics of the continent a desire to study the treasures of art in the museums of Europe may have been a lure, which drew him to Europe upon the completion of his medical course in Harvard and of his year of residency in the Massachusetts General Hospital. However that may be, both in his vocation and in his avocation he gained immeasurably from the postgraduate years spent abroad and when he came to Cleveland in 1883 to begin the active practice of his profession, it was not surprising that with the equipment gained from his prolonged studies added to his natural abilities he soon became marked among his fellows.

In his surgical career here, perhaps nothing is more characteristic of the singleness of purpose of the man as far as his profession was concerned, than his preference to retain a minor teaching position in surgery in the medical school until the chair of surgery was tendered him, rather than, at a far earlier date, to accept a promotion to the chair of gynecology.

For brief successive periods he served on the staffs of the Cleveland City, and of St. Vincent's Charity Hospital, and in 1886 went to Lakeside Hospital where he served continuously until his resignation in 1910. Throughout this period although never a prolific writer he was an occasional contributor to medical journals, his articles covering a wide diversity of subjects, for he was in no sense a surgical specialist. He was an excellent teacher and had the gift of presenting clearly and concisely salient clinical and technical points.

Dr. Deaver has well summed up the outstanding professional characteristics of Dr. Allen:

"Doctor Allen's standing in the surgical world must be judged by his ability as a hospital organizer, as a teacher of surgery, an operator, and by the inspiration of his personal contact. His contributions to medical literature consisted chiefly in addresses and articles for journals, important articles with which we are familiar, and which treat of a wide range of subjects, but especially in the domain of abdominal surgery. Prolific contribution to surgical literature is not a characteristic of the class of surgeons of which Doctor Allen was a leader, the essentially practical man. His several writings invariably deal with the subject from the viewpoint of the clinician. As a successful operator he was naturally interested in the development of the technical side of his art, rather than of the theory, and not a few of his literary efforts deal with anæsthesia, asepsis, and postoperative treatment.

"Dudley P. Allen will always be remembered in this community as a highly successful practitioner of surgery; his reputation abroad will endure as an inspiring teacher of surgical principles, as the leading spirit in the development of an excellent medical school and hospital, and finally, as a leader in the societies devoted to the improvement of his specialty."

It is not often that it is given to a man to achieve almost as much recognition in his avocation as in his vocation but that was the happy lot of the subject of this sketch. Resigning from his practice while still it was expected that many years of usefulness remained to him, Dr. Allen turned his devoted interest to the support of two institutions in Cleveland—the Museum of Art and the Cleveland Medical Library. A journey around the world gave him the opportunity for extending his knowledge of art and enlarging his private collection and upon his return he became a trustee of the Cleveland Museum of Art and bore a large share in the extension of its activities. His interest in music claimed also a share of his attention. In particular he was actively interested in the promotion of the interests of the Medical Library Association of which he was the president from 1903 to 1906. It is principally due to his efforts and to his gifts that the Cleveland Medical Library has the distinction of being one of the important medical libraries in the country.

In the midst of these activities, while his friends and co-workers were looking forward to many fruitful years of service to the community, Dr. Allen died suddenly of pneumonia in New York City on January 6, 1915, leaving a permanent impress upon the professional, the artistic, and the social life of the community in which he had made his home for thirty-three years. GEORGE W. CRILE.

CORRESPONDENCE

THE TREATMENT OF BRAIN ABSCESS BY UNROOFING AND TEMPORARY HERNIATION OF ABSCESS CAVITY WITH THE AVOIDANCE OF USUAL DRAINAGE METHODS

To the Editor: The article by Joseph C. J. King on the treatment of brain abscess by unroofing and temporary herniation of abscess cavity, etc., which appeared in the November, 1924, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, provides mental pabulum for every surgeon who has lost a patient after drainage of a cerebral abscess. In the early part of the late war, I was faced by the problem of how to drain a sinus, caused by a projectile, extending for 3½ inches exactly beneath the left motor area, half an inch below the surface of the brain. The treatment usual for sinuses other than cerebral was adopted, i. e., the sinus was laid open in its whole length; the dura, which was not reflected, and the brain, being divided together by cutting down on a director passed along the sinus. No drainage material was placed in the sinus. A perforated rubber tube was placed between the scalp and the dura, the scalp being partly sutured over the tube.

The usual hernia followed, pus and brain sloughs were extruded beneath the scalp and removed by irrigation. Recovery ensued, with very moderate partial hemiplegia. (Details of this case are given in the *British Journal of Surgery*, iii. No. 11.)

My suggestion is that in certain cases, especially those in which excision of the roof of the cavity would entail the sacrifice of important cortical areas, the laying freely open of the whole length (and breadth) of the cavity, by suitable incisions in the roof of the cavity, may prove an efficient substitute for excision of the roof of the abscess.

C. HAMILTON WHITEFORD, M.R.C.S., L.R.C.P. Plymouth, England.

ERRORS IN DIAGNOSIS IN FIVE HUNDRED LAPAROTOMIES A CORRECTION

To the Editor: In my article, "Errors in Diagnosis in 500 Laparotomies," appearing in the February, 1925, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, there occurred a typographical error in the conclusions that did not appear in the text proper. It was stated that "0.75 per cent cures of chronic appendicitis were corroborated by a follow-up record." The percentage of cures was 75 per cent instead of 0.75 per cent.

R. M. HARBIN, M.D.

Rome, Georgia.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD JANUARY 16, 1925, DR. CAREY CULBERTSON PRESIDING

THE SEDIMENTATION TESTS IN OBSTETRICS AND GYNECOLOGY

DRS. JOSEPH L. BAER and RALPH REIS read a paper discussing the sedimentation tests in obstetrics and gynecology (see p. 691).

DISCUSSION

DR. JOSEPH L. BAER: This work followed the work on capillary microscopy and was developed by the same man, Linzenmeyer. The points which Dr. Reis has made are not conclusive. We feel we are doing a bit of pioneering, and hope others will become interested in the same field. Certain things stand out definitely. The sedimentation reaction is very sharply defined. It is striking to see the rapidity with which the red cells settle in acute infections. A sedimentation time of 6 minutes means that in 6 minutes the red blood cells have settled as much as they would in 6 hours under normal circumstances. That is a very striking reaction. It remains to be seen how best that can be applied not only in our specialty but in medicine and surgery generally. We found that in obstetrics the reaction had no value for the early recognition of pregnancy. In abortions it has a value in picking out mishandled abortion cases or cases in which there is about to be an acute flare-up, shown by rapid settling of the red cells. The reaction may be described in units of time or in millimeters of column of red cells. Some prefer the 18 millimeter standard and others prefer the time standard—the distance to which the level of red cells has descended in a certain period of time, 1, 2, or 3 hours. We have chosen the 18 millimeter standard rather than the hour standard.

The test has no value after the patient has been operated upon. An incision promptly changes the rate of sedimentation, the red cells falling rapidly even in clean cases. In gynecological work we found it was particularly valuable in differentiating between infected and non-infected cases, and in puerperal sepsis we found that it had a distinct prognostic value. The ominous cases are those in which sedimentation is rapid, and the favorable cases, those in which sedimentation is slow. It is perfectly easy with a very small needle to repeat this test every third day or oftener. It should not hurt and the amount of blood lost is so small that the patients do not object. Dr. Reis mentioned the method of Linzenmeyer in which a pipette and a single drop of blood is used. That method is generally disapproved of because it introduces other factors, such as capillary attraction. The literature in the last few years contains many articles with conclusions mostly favorable for continuing the test. We hope in the coming months to increase our own series to a point where we will be free to draw our own conclusions.

DR. WATKINS: Have there been any reports regarding the time of coagulation in acute infection?

DR. BAER: I cannot answer that, as the scope of this work did not include studies in coagulation.

DR. HEANEY: Why does operation disturb it?

DR. BAER: The writers who call attention to that say the reaction from the healing process of the wound sends by-products into the blood stream which seem to disturb the chemical state of the red cells. It is very interesting to read the various theories regarding this test. As Dr. Reis said, no one man has been able to convince any other man that his explanation is right.

DR. T. DOEDERLEIN: I do not quite understand the advantages of this test over the leucocyte count. Our leucocyte count is a very fair criterion of infection. As far as I can see this only corroborates the leucocyte count.

DR. RUDOLPH HOLMES: Have you taken into consideration the blood count in a woman who has four million red cells? Would not the fact that the count is one million short make the rate more rapid?

DR. N. S. HEANEY: This is a very nice piece of work and I think the authors deserve to be complimented. Now Dr. Reis undoubtedly means that when the sedimentation time is below an hour the infection is still highly virulent and if the patient is operated on there is liable to be a fatal conclusion to the case. He infers that all pus tubes are to be operated on and it only remains to have a safe time in which to do the operation. The inference is wrong, though possibly the statement is right.

DR. JOSEPH L. BAER: The question Dr. Doederlein asks was partly answered in the paper. The leucocyte counts and the sedimentation readings were made on the same cases running parallel. The results show that while the leucocyte count remained stationary the sedimentation test was rising or falling and in keeping with the clinical progress of the case. We have not watched the red-cell count. The effect that it would have on sedimentation readings would be very minimal. A 20 per cent drop in the red count would not play a very positive rôle. Those

who have studied this angle of the problem ignore the factor of anæmia in successive readings on a given case.

In answer to Dr. Heaney, we certainly do not sponsor the dictum that all pus tubes should be removed. I have delivered women who previously had had gonorrhœal pus tubes. However, we will clarify that statement so that there can be no misconception about it.

Dr. Ralph Reis (closing the discussion): Nothing was said about pus tubes. I do not think there is anything further to add except that we are going to keep on with the work and see if we cannot get more definite conclusions than we have arrived at so far. We have had several hundred cases but we want to get more. In addition we mean to do more work on our pus-tube cases. The test was meant especially to help us find a time when an infection in the pelvis had become quiescent in order to avoid operating either during the acute stage of the infection or at a time when an old quiet infection was again becoming acute.

PROLAPSE OF THE FEMALE URETHRA

Dr. Thomas J. Watkins presented a paper on "Prolapse of the Female Urethra" (see p. 687).

DISCUSSION

Dr. W. C. Danforth: I think we agree with Dr. Watkins in his conception of the transverse tear and also in his explanation that it is a result of dragging down of the anterior lip either by an ill-advised delivery at too early a time or by the pushing down of the cervix by the advancing head. The observation of a number of obstetrical cases, normal otherwise, shows that the anterior lip may be caught between the advancing head and the symphysis. By rectal examination, the œdematous anterior lip is easily made out, and it is found to be lower than in a fully retracted cervix. Allowing the labor to proceed with this condition tends to expose the woman to greater injury than is necessary. It is easy to dispose of the condition by gently making pressure on the cervix during a pain, at which time it will slip over the head and come to occupy its normal position. The condition is often seen in multipara. It is well worth while keeping in mind, because the number of cases of cystocele which follow 2 or 3 months after delivery may be diminished.

Dr. A. H. Curtis: There are two facts which Dr. Watkins brought out which are worth further emphasis. One is that a good many relaxations of the anterior vaginal wall cannot be recognized until the patient stands and strains. We all overlook the diagnosis of such conditions because we forget to make this test.

The second is that caruncle is frequently associated with sagging of the bladder and the upper urethra. It is probable that nearly all, except those so-called caruncles which we find in connection with gonorrhœal infection, are secondary to cystocele and urethrocele. It is because we have failed to correct these conditions that caruncles so often return.

Dr. C. B. Reed: In Dr. Watkins' discussion of the etiology I would be curious to know whether he differentiates completely between the head which comes down by force and the head which is driven down by contractions. It seems to me a tear is logical in either case. Another point is the effect of prolonged labor on the vaginal walls. In the cases of prolapse of the pelvic genitalia which have come to my notice I have found that nearly all of them can be traced to labors which were unduly prolonged, the cause being found in the protracted overstretching of the elastic fibers which never returned to normal. In the effort to save a perineal body which is relatively unimportant as far as support is concerned we have destroyed the good elastic fibers of the vagina itself. It seems to me that prolongation of labor with overdistention when the head is disproportioned is just as important in the etiology of prolapse as long labors with forceps or long labors with disproportionately large heads.

Dr. T. Doederlein: I was especially interested in the way in which Dr. Watkins described the handling of the redundant mucosa. In my numerous bladder operations I must confess I have paid very little attention to the urethra proper. I follow the principle of Rawls which he laid down 5 or 6 years ago, of dissecting out the urethra and loosening up the bladder back to the arcus tendineus and then raising the bladder, putting the urethra pretty well on the stretch and then fastening by imbrication the fascia of the triangular ligaments over the urethra and bladder. Dr. Watkins was speaking of a detachment of the wall of the bladder. I have had occasion to notice quite frequently during labor that the bladder is loosened and inserted lower down in the cervix, and consequently we have a lower insertion of the bladder—the so-called sliding detachment. If it is not loosened from the cervix the cystocele will not be corrected. My idea was that by loosening the entire bladder and raising the bladder above the uterus and putting the urethra on the stretch the whole condition would be corrected. I operated upon quite a few cases before I left for India and also during my stay in the Orient where bladder conditions frequently are a sequel of protracted labors. The results were very good. I confess I never did anything to the mucosa as Dr. Watkins outlined. In the future I shall pay more attention to that.

Dr. W. M. Thompson: The average surgeon has not much conception of the condition present in cystocele and rectocele and he does the old time operation and consequently has failures. It is very evident from Dr. Watkins' diagrams that the transposition operation if properly done is a success because it corrects that separation of the fascial wall below the bladder. If more attention is paid to the anatomic structures and the distention of the fascia at labor, many women will be cared for at labor and will not be coming back after a long period for operation.

DR. MARK GOLDSTINE: If a patient, after her first child, has considerable sagging of the urethra and some incontinence, should that be corrected if she is going to have more children or would Dr. Watkins think the condition should be let alone until she has passed the child-bearing period?

DR. ALFONS BACON: I would like to ask two questions. In the postnatal clinic at the Cook County Hospital we see a great many patients about 3 months after delivery who on examination show a considerable stretching of the anterior vaginal wall although the perineum is in good condition. There is no prolapse of the mucosa of the urethra but there is considerable gaping at the vulva. This vaginal wall appears rather firm and the urethra is rather firm. I wonder if this is to be considered as a urethral prolapse and whether there has been considerable tearing of the fascia. I would also like to ask what we might recommend in the treatment in these cases. Most of the patients are poor women with nursing babies who cannot afford much time in the hospital.

DR. GEORGE GALLOWAY: Nothing has been said in regard to episiotomy or cutting of the perineum to allow the head to drop down. I wonder if that may be a factor or if it occurs too late.

DR. EMIL REIS: When I was a student we were taught that the urethra in a normal woman forms a considerable curve around the symphysis; that when tears occur, the muscular coat of the urethra becomes much shorter, because the urethra instead of going through a curve becomes straight in prolapse so that there is a redundancy of mucosa. That explains the success of the Emmett operation in which the mucosa is stretched until it is as long as the muscularis of the urethra.

DR. T. J. WATKINS (closing the discussion): The histories of these patients are interesting. Very often they have some incontinence and fail to mention it. I was expecting some of the obstetricians to speak of the full bladder as a cause of urethrocele. As students we were taught that the full bladder was probably the most important factor. Lately, however, it has occurred to me that perhaps a certain amount of urine pulls the head out of the way as it comes down, and the bladder is saved.

Since we have been operating on these lesions with thorough dissection I recall only one case in which there was not a distinct absence of the fascia in some places. This case was encountered about 2 weeks ago. There was a great attenuation although the woman had a large cystocele. The fascia was extremely thin.

I was interested in what Dr. Doederlein said about imbrication of the fascia and in his observations relative to the bladder pillars. I have seen Dr. Rawls operate, doubling the fascia upon itself, but I have never seen the logic of it. We have been impressed that the bladder pillars are in the mind of the artist and not in the patient. If you have a lesion in which there is a distinct hernial opening, then the only logical thing is to close this by pulling the tissue back and tacking the sac about the urethra.

Dr. Goldstine spoke about the child-bearing period. I think it is extremely important in the repair of all lesions of the pelvic floor. We believe that most lesions of the pelvic floor should be treated in a palliative way until the patient is through having children for two reasons: thorough repair of the pelvic floor makes labor more difficult and in labor following such repair there is always danger of the injuries requiring a subsequent operation. An exception should be made in patients who are very uncomfortable from the pelvic lesions.

In response to Dr. Galloway's inquiry, having had little experience in obstetrics I cannot answer authoritatively. It would seem to me much better to incise the cervix rather than subject the patient to the danger of cystocele.

Dr. Reis' discussion of the etiology of urethrocele interests me greatly. I believe that excessive mobility of the mucous membrane usually is subsequent to the prolapse.

RESIDUAL URINE IN WOMEN

DR. ARTHUR H. CURTIS read a paper of this title (see p. 689).

DISCUSSION

DR. H. O. JONES: In the last 3 years we have had 15 cases in which the labor was long drawn out. Repeated catheterizations were required for the first few days, and thereafter tests were made each day for residual urine until we were absolutely sure that the patient was able to empty the bladder. In no instance was there subsequent evidence of bladder or kidney infection. The relief experienced by these patients is in contrast to the discomfort incident to urinary tract disturbances which we formerly observed in certain difficult obstetrical cases.

DR. W. C. DANFORTH: I fully agree with Dr. Curtis as regards catheterization in operative cases. One point I think he did not emphasize sufficiently is in regard to failure to empty the bladder in obstetrical cases. The routine Dr. Curtis has advocated for testing the ability to empty the bladder is just as important in obstetrical cases as in gynecological cases. We have our patients catheterized every 8 hours, and then when voluntary urination returns the catheterization is continued until the bladder empties itself completely.

DR. JOSEPH L. BAER: Often when I have ordered catheterization to relieve a desire to urinate I have been surprised at the small amount of urine obtained. If discomfort is to be our indication for catheterization I am wondering whether there has been some error in my operative technique or whether the discomfort is often due to manipulation about the trigone. Should it be the latter, may we not sometimes institute catheterization earlier than is necessary in some of our postoperative cases?

I would like to ask Dr. Curtis how much urine may be found in the bladder before he would apply the term residual?

DR. THOMAS J. WATKINS: There are two points I would like to discuss. First, we have often been chagrined of late upon finding patients who void small amounts at frequent intervals or suffer with the distention of the bladder reported as having acute infections. Every now and then nurses, internes, and even occasionally the attending man will fail to recognize this condition. This proves entirely what Dr. Curtis has said.

Again, there is the question of instillation after catheterization for residual urine. I have been impressed with the possibility of irritation from the instillation of silver nitrate and argyrol. We are now, at the suggestion of Dr. Curtis, employing ½ per cent mercurochrome. It is relatively non-irritating and appears to leave little residue.

DR. N. S. HEANEY: I think Dr. Curtis has done a great deal of good by repeatedly emphasizing the importance of retention of urine after operation, but I think there has been some misconception of his teaching on this subject. I am pleased to hear him emphasize that if the patient empties the bladder after operation, but does not empty it too frequently, it is an indication that she has no retention. For example, if she voids 200 or 300 cubic centimeters at regular intervals the probabilities are that employment of the catheter will reveal no retention; but if a catheter has been inserted and retention is found, she should then be catheterized daily until she can empty the bladder completely. We have arbitrarily taken as an indication that the bladder is thoroughly emptied if the catheter reveals less than 30 cubic centimeters. I wish we might be informed of the limit of the normal amount to be found in the bladder.

DR. CURTIS: The urine should be perfectly clear and not more than an ounce in amount.

DR. IRVING STEIN: Since Dr. Curtis' previous paper I have been very religiously employing the principle involved both in obstetrical and gynecological cases, being careful to carry out the rule that the first catheterization should be avoided, particularly in obstetrics. I have modified the plan somewhat by preceding the catheterization with the insertion of a mercurochrome saturated applicator into the urethra. I have also inserted into the bladder ½ ounce of 1 per cent mercurochrome solution. We have had no irritation in patients who have had residual urine even for a period of many days nor can I recall a single case of cystitis that occurred in this series.

DR. MARK T. GOLDSTINE: Will Dr. Curtis tell us whether there would be any objection to leaving in an in-dwelling catheter at the time of operation? I have tried it with much satisfaction.

DR. A. H. CURTIS (closing): By residual urine we mean the amount left in the bladder after spontaneous evacuation. If a patient requires catheterization for 3 days; then starts to void and does it quite freely, we realize from experience that there is a residue. We then pass a catheter once each day as long as a notable amount of urine is obtainable. This may be more than 1 ounce.

Our experience has differed somewhat from that of Dr. Baer. Perhaps he makes his incision closer to the urethral meatus than we do. Most of our patients have little distress until there is an accumulation of at least 8 or 10 ounces.

Much as we dislike to admit the occurrence of complications we must realize that there is occasionally a mild cystitis; this, however, soon disappears. In the average case the residual urine is not present for more than 5 or 10 days. No further treatment is necessary after the patient leaves the hospital, because once the residual urine has disappeared the trouble is relieved.

REPORT OF A CASE OF DYSTOCIA DUE TO RIGOR MORTIS OF THE FETUS IN UTERO

DR. C. P. BAUER: This was a patient of Dr. Irving F. Stein. The patient was a para-i, whose last period was February 27, 1924. She felt quickening on July 12 and was estimated to be due December 4. She came to the Michael Reese hospital December 21 in labor. The heart tones were audible in the left lower quadrant, taken at 15 minute intervals, from 6 p.m. until 10:05 p.m., at which time it was reported that heart tones could no longer be heard. The heart tones had varied from 140 to 150. At 1 o'clock the membranes ruptured spontaneously. There was a great deal of meconium in the liquor amnii. At 2:30 there was complete dilatation and forceps were applied. There was a good deal of difficulty in bringing the head from mid-plane to the pelvic floor, and although an episiotomy was done it was almost impossible to deliver the head over the perineum. In spite of considerable traction on the head, and Kristellar's expression the shoulders would not engage in the pelvis. Finally Dr. Stein introduced his hand into the vagina along the side of the head and hooked one finger under the posterior axilla and by this means was able to extract the fetus, experiencing resistance all the way. The fetus as it lay on the bed was in the typical attitude of flexion that it assumed in the uterus. Both upper and lower extremities were very rigid. The head was sharply flexed on the chest. The spine was also flexed. The dystocia was undoubtedly due to the fact that the fetus could not follow the normal mechanism necessary for normal labor. The fetus weighed 7 pounds. Its measurements were in no way abnormal. The measurements of the mother's pelvis were—spines, 26, and crests, 28, with a Baudelocque of 19.

DISCUSSION

DR. IRVING F. STEIN: This case is reported to learn whether the other obstetricians in the Society have seen this condition of dystocia due to rigor mortis of the fetus before delivery. I believe it is an exceedingly rare observation. In making a rather complete survey of the literature in the last few weeks I find that the only American citations are in DeLee's textbook, and one by Paddock in 1903.

There was one English and one German citation with a small number of cases reported and quite an interesting discussion. Our own impression was that we had never seen it before nor had other members of our staff whom I asked. Dr. DeLee told me he had observed it two or three times. I think the following conclusions may be drawn concerning this condition:

1. That a baby may be born in a state of rigor mortis and that rigor mortis may develop in the uterus.

2. That rigor mortis of the fetus may be the cause of dystocia and that the dystocia is due to the fact that the fetus is rigid.

3. The fetus cannot deflex or lateroflex during labor to accomplish the normal mechanism.

4. It requires a great amount of strength to extract even a normal size baby through a normal birth canal if the baby is in a state of rigor mortis.

5. That a fetus is rarely observed born in rigor mortis and even more rarely reported than observed.

6. That if we were to study the time element involved in the production of rigor mortis *in utero* we might be guided by it, that is, if we could know that when the heart tones disappear it takes two hours for rigor mortis to develop and that rigor mortis may be present for twelve hours we might perhaps modify our procedure, and avoid deliberate extraction of a baby in this state.

I might be criticized for extracting a stillborn baby with forceps. I took a chance on a forceps extraction, hoping that the fetus might still be resuscitated. The difficulty was greater than I have experienced in the deflection attitudes or persistent occiput posterior. I believe the death in this instance was due to postmaturity; there were no cord complications. The placenta showed a high degree of calcification. When we tapped it with instruments it gave a clicking sound. This labor occurred 3 weeks past the estimated date. We urged the woman a week before to come in for induction of labor but she refused.

REPORT OF TWO CASES OF PLACENTA PRÆVIA WITH LOW INSERTION OF THE CORD

Dr. George Galloway: I have had 2 cases of placenta prævia with low insertion of the cord. One was in a Chinese woman whom I saw on December 29 for the first time. She had been in labor for 3 hours. She was a para-ii. Something like 1,500 cubic centimeters of blood had been passed. I sent her to the hospital at once. The heart tones were audible when I first saw her. Her pulse could not be counted at the wrist. Examination in the hospital revealed a placenta prævia marginalis; about 2 centimeters on the surface of the cord was the marginal insertion coming out right on the cervix. The patient was in a state of shock and was bleeding profusely. She was given 1,000 cubic centimeters of saline under the breasts and a little morphine. Her pulse came down from 160 to 120 and after about 2 or 3 hours we inserted the bag and the fetus followed very shortly. The patient's hæmoglobin was 53 and blood pressure 98. She recovered rather promptly and insisted on going home on the tenth day. I have heard from her since and she is making a good recovery.

The other case was one which I saw for the first time for another doctor on January 2. She had had a spontaneous hæmorrhage while at stool without any pain. I sent her to the hospital merely on the strength of the hæmorrhage. Delivery was due March 15. I kept her in bed for 10 days. She did not have any more active bleeding. Her hæmoglobin was 85 and blood pressure 120. The fetus was alive and the heart tones good at that time. The day before yesterday the membranes ruptured at 2 o'clock in the afternoon. We administered a sedative and kept her quiet. Last night she had a temperature of 100 and a pulse of 120 and her face was quite flushed. She gave no positive findings in the lungs or anywhere else. We decided to induce labor with castor oil and quinine, and she went into labor quite promptly at 10 o'clock. At 12:30 she was bleeding rather profusely. On rectal examination I could not determine anything. Between 200 and 250 cubic centimeters of clots were expressed. Finally a vaginal examination was made and through about a 4 centimeter area the placenta could be palpated almost completely across the cervix. The cord was down in front of the head. I tried to reduce it and get it out of the way. On account of the profuse hæmorrhage the bag was inserted. Her pulse was about 150. We gave her 500 cubic centimeters of salt solution under the breasts. She was quite restless. In a couple of hours we gave her some pantopon to relieve the pains which were quite frequent and hard. About 5:30 she expelled the bag and the fetal head followed it rather promptly without any bleeding. The placenta came away in about 12 minutes and it had the cord inserted almost at the opening of what corresponded to the cervix at that time. The cord not only was low but had run under the membranes for some distance toward this portion of the placenta. If the head had come down first it would have killed the baby. Today her temperature was 100 and hæmoglobin 65 and the red cells 3,000,000. She had no bleeding.

A Table of luxations and diſlocations.

Place this Table in folio. 26.

Euerie luxation or diſlocation is either

- Simple, and it is either
  - Imperfect, and that is either
    - Luxation.
      - perueniō, of which there are iii. kinds, for either the ſubluxatiō is
        - Forwards, & is called Lordoſis
        - Backwards. & is called Cyphoſis
        - Sidelong. & is called Scoliosis,
  - Perfect.
- Compound be either
  - Imperfect.
    - Of theſe compound Luxations both perfect, and alſo imperfect, the chiefe differences are theſe following, as
      - Luxation with a fracture.
      - Luxation with an inflammation.
      - Luxatiō with a wound
      - Luxation with dolor.
      - Luxation with hardneſſe,
  - Perfect.

A Table containing the differences of fractured bones.

Place this Table in folio. 25.

Euerie fracture of the bone is either

- Simple fracture of the bone, of which there are iii. kinds, that is,
  - 1. Couerwarts, and they are three, that is,
    - 1. Cauledon, when as the bones are broken like
      - Stalkes of hearbes,
      - Radiſh,
      - Cucumbers.
    - 2. Raphanidō,
    - 3. Sycedon,
  - 2. Rifts or fiſſures called Schidacidon.
  - 3. broken in many ſmall peeces, named Alphitidon.
- Compound and ioyned with it both.
  - Sickneſs as a fracture with
    - a Wound.
    - Gangrena.
    - inflāmation
    - Erysipelas.
    - intēperatnes
    - &c.
  - Accidēs as a fracture with
    - Itching.
    - dolour, &c.

Albucasis nameth other differences of Fractures: as a fracture of the lawes, a fracture of the noſe, a fracture in Cranio, a fracture of the ſpine of the backe, a fracture of the foſſiles, &c. Which be no true differences of fractures, but rather noteth the part affected.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

CERTAINE WORKES OF CHIRURGIE, NEWLIE COMPILED AND PUBLISHED BY THOMAS GALE, MAISTER IN SURGERIE, LONDON PRINTED BY THOMAS EAST, DWELLING BETWEENE PAULES WHARFE AND BAINARDS CASTLE, 1586[1]

UNDER the above title the results of Gale's life work appeared in 1586. In the same volume appears also Gale's translation of the works of John DeVigo for whom he apparently had great admiration, though in his work he speaks also of other older physicians and is one of the few authors who gives due credit to Jerome of Brunswick. Gale's works appeared first as lesser publications in 1563, two years after his return from the campaigns with Henry the Eighth and Phillip the Second of Spain. Appearing as they did only a few years after the publication of Paré's work it is interesting to note that both Paré and Gale had come to approximately the same conclusions as to the treatment of wounds and particularly to the belief that in infected gunshot wounds gunpowder was not the etiological factor. Gale does not mention Paré though he does mention many of the older authors. It is interesting to speculate whether three great surgeons of this time, Paré of France, Gale of England, and Dalla-Croce of Italy, each serving in the wars, met and evolved the ideas which they promulgated or each came to the same conclusion independently.

Thomas Gale was born in London in 1507. He studied under Richard Ferris and John Field, two of the greatest of English surgeons of the time, and the latter he makes one of the speakers in his work entitled "An Institution of a Chirurgion." After practicing in London and gaining considerable reputation he entered the army of Henry the Eighth and served in the Battle of Montreuil in 1544. Later he entered the army of Phillip II of Spain and went through the Siege of St. Quentin in 1557. He thus had experience in military surgery for approximately fifteen years before he returned to London and reentered private practice in 1559.

According to the introduction, Gale had written the "Institution" and "Enchiridion," or at least started them, when he was called away to the wars. He writes, "Wherefore I dyd set pen to paper, and wrote an Enchiridion of Chirurgerie, conteining the methode and way to cure wounds, both in similar & instrumentall parts, and eke fractures and luxations, with a new way of stanching flux of bloud, without cauterising yrons, by a poulder designed by Maister Pierpont and mee, when as any member is taken off from the bodie, & is now in the Hospital of London, used to the great comfort of the sicke people, & safegard of their lives where commonly before they perished & decayed: and while I thought here to have staid, behold, wars followed, and controversie arose, whether the cure of wou(n)ds made with com(m)on gonpouder and shot, were like to invenomed wou(n)ds, or else wounds contused, which controvercie to decide, I thought for the tyme necessarie, and have compiled a little volume, confuting the adversaries opinions, & establishing myne owne,"

These two points, the doing away with the cautery and the care of gunshot wounds are, with the exception of his classifications, Gale's most important contributions to the surgery of the time. His classifications or rather graphic tabulations of Tumours against Nature, Wounds, Ulcers, Fractures and Dislocations are most interesting. The latter two are reproduced here.

The work is written for the laity as well as for the student of medicine and one of the impelling reasons for writing it was Gale's endeavor to raise the standard of surgeons, rather than of surgery. His list of the type of persons practicing surgery is anything but high class. He lays one cause of this to the fact that in order to study surgery it was necessary to know Latin. Consequently, in addition to his own original work, he published a "Commentary on Guido de Cauliaco"; "An Epitome of Galen de Natural, Facult."; "Certain Workes of that famous Chirurgion Maister John Vigo"; all printed in English. This great interest of Gale's in establishing surgery on a higher plane was apparently well known for one John Hall writes an introductory poem for a division of Gale's work. In part it runs—

"Chirurgerie whose perfect light all other Realmes do know,
Whose learned men with diligence, dooth make it shine and show,
In our coast hath not yet appeared, save in most obscure wise,
Through dusky cloudes of ignorance, that science doth despise.
But maugre now the mallice great, of Momus and his sect,
A most cleere Gale doth blow awaie, those cloudes, and them detect."

Gale became Master of the Barber Surgeons' Company in 1561—and died in London in 1587.

[1]Reviewed by the courtesy of Dr. J. L. Miller, Thomas, West Virginia.

REVIEWS OF NEW BOOKS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Missouri

BY calling attention to a new book on therapeutics[1] I feel that I am rendering a distinct service to the readers of this journal. While therapeutics occupies a legitimate place by itself in the curriculum, it seems to me that its exclusive assignment to the realm of internal medicine is largely a matter of tradition. Surely, a knowledge of drugs, biological therapy and prophylaxis, organotherapy, hydrotherapy, mechanotherapy, electrotherapy, psychotherapy, etc. (all these, by the way, are chapter headings in the book under discussion) must be acquired and once acquired must be kept up to date by all of us whatever our special line of work may be. The general subjects just mentioned, together with several others such as balneology and radiotherapy, etc., form the first part of the work; the second part is devoted to special therapeutics and comprises the application of therapeutics to more specifically "internal" diseases, e.g., infectious diseases, diseases of metabolism, of the blood, the cardiovascular system, the digestive tract, the respiratory system, etc. I am not competent to judge whether this second part is on a par with the best literature on these subjects—though it seems to me to be the case—but I am quite certain that the first part is equal to anything I have ever read along the lines of general therapeutics. If I may here interpolate a wish, it is that protein therapy be given more space in the next edition.

It is, however, in the manner and originality of presentation that this book occupies, in my estimation, an outstanding position among medical textbooks. All subjects covered are described in a most lucid fashion, and everywhere the relations of therapeutics to physiology and pathology are stressed. All methods of therapeutic procedure are given so clearly and minutely that a person who has never heard of them, could do them from the description. The historical method of approach adds zest to the study and satisfies the natural curiosity regarding how this and that remedy first came into use.

All these points, I doubt not, may be found in other prominent works. What distinguishes Clendening's book is his use of, and joy in, beautiful language, the wide cultural background of the author, and a keen sense of humor which sparkles through the pages. The subject of constipation and cathartics seems least likely to offer opportunity for humorous treatment, but let the reader judge for himself. ". . . for occasional use—for the person who wants a cathartic once a fortnight—pills, and particularly aloes-containing pills, are ideal. Various persons have floated their names down the river of time upon 'dinner pills,' the principal ingredient of which is aloes: there is Chapman's dinner pill, Hall's dinner pill, and Cole's dinner pill; and finally Lady Webster's dinner pill, which has intrigued my imagination for many years. I have no idea who Lady Webster was, but the mention of her pill brings to my imagination a vision of her in the baronial castle giving endless dinners and dispensing endless pills to cowed curates and squires, with the benevolent despotism of a strong minded dowager, who has suddenly in mid-age become intensely interested in the large intestine."

Let me select another characteristic sample. Speaking of the necessity of considering the whole individual and not merely a part, when patients with so-called visceroptosis are to be treated, the author insists that "the physique of these individuals is the keynote of treatment. All human bodies are not alike. In general three main types can be distinguished: (1) the normal, medium type; (2) the broad, heavy type; (3) the narrow, light type. Every possible subvariety may be differentiated so that a line of human beings could be set up, ranging from the thin long visceroptotic at one end to the broad heavy strong Clydesdale at the other, and yet any two bodies side by side would show a difference almost imperceptible. None of these bodies need be definitely pathological—none the seat of actual anatomic disease. And yet, by the very nature of their physique they . . . are fated to certain pathological tendencies. . . . Down at the thin end are the pessimists—the people who advise you to put your money in the bank, and that a rainy day is coming; they like funerals and divorces and bankruptcies, and Chopin and solitaire and Dostojevski and going to bed early, and Christina Rosetti and cascara sagrada and Schopenhauer and the sterner forms of Presbyterianism. Up at the broad end are the optimists—they believe in having a good time while you are living because you will be a long time dead, and to them things are looking up; they like births and marriages and stock dividends, and Mozart and bridge and Dickens, and dropping over to see if the Hummels are awake, and Browning and whisky sours and William James and the Episcopal church—(and their enemies are hypertension and nephritis and apoplexy and gall stones and obesity and the pitiful age of fifty)."

Could any classification be more delicious and more descriptive? But I must stop here lest this review grow into a dissertation. Moreover, the reader will be impatient to discover other gems in the book for himself, and he will be as grateful to the author as I am, for the unalloyed pleasure he has given us while increasing our knowledge.

[1] Modern Methods of Treatment. By Logan Clendening, M.D. With Chapters on Special Subjects by Various Collaborators. St. Louis: The C. V. Mosby Company, 1924.

IN the autobiography[1] of a famous German gynecologist which has recently appeared may be found many interesting details of the evolution of gynecological surgery particularly during the last two or three generations. August Martin, whose towering personality has been a landmark in the gynecological world in the last 40 years or more, has often reminded me of Samuel Johnson with his Gargantuan stature, his intrepid disregard of mere tradition and authority, his originality of thought and action, his brilliant power of expression, even with his pleasure in good food and drink; and now he has become his own Boswell and has given us an insight into a long life filled with work, full, too, of strife, but finally crowned with universal respect and recognition. Martin's beginning fell into the embryonal period of gynecology when this specialty began to develop out of its surgical and obstetrical roots; and the decisive influence our author exerted on the growth of gynecology can well be attested by the thousands of physicians from all parts of the world who studied under him. Those who know Martin personally, will find many memories reawakened by these reminiscences. But even without a personal acquaintance, this little book affords an intensely interesting survey of modern gynecology, subjectively colored, to be sure, but nevertheless portraying vividly significant trends and the great pathfinders who made gynecological history for us. It is astounding to read of the many contacts which Martin has made in his life—among Americans, to name but a few, Marion Sims, Cushing, Howard Kelly, Bacon, Hermann Boldt, Arthur Stein; in France, Péan, Pozzi, Doyen; Balfour in Scotland; in Italy, Morisani; in the Nordic countries, Engstroem, Leopold Meyer, Essen-Moeller, and many, many others, not to mention the leaders, old and young, in Germany and Austria. It is clear that such an intercourse must have produced reciprocal effects. His extensive travels led Martin twice to America, and it is both instructive and amusing to see ourselves as others see us.

The *exclusively* surgical era of gynecology of which Martin was an eminent exponent, has reached its close; yet, its value for the further development of our specialty remains undimmed. Martin has outlived the scriptural three score and ten. May he remain among us much, much longer to see the fruits of his labors bear a rich harvest!

[1] WERDEN UND WIRKEN EINES DEUTSCHEN FRAUENARZTES. Lebenserinnerungen. By A. Martin. Berlin: S. Karger, 1924; London: Baillière, Tindall & Cox, 1924.

EVERY new edition of DeLee's work[2] deepens in the reader the conviction that this book is splendidly adapted to the teaching and learning of obstetrics. Its excellent features have been stressed in previous reviews. The present, fourth edition, is strictly up to date. The author seems to have overlooked nothing new that has been brought forth in the domain of obstetrics, from Felix' work on the primordial follicles and Schroeder's investigations of the uterine mucosa to the administration of insulin in hyperemesis. A clear distinction is needed between hospital and home obstetrics, and as the largest number of births is conducted by the general practitioner, it is to the needs of the latter that the book is devoted primarily. For this reason, a strongly conservative attitude is observed throughout, "watchful and armed expectancy" is urged emphatically, and the indications for cæsarean section, forceps, version, pituitrin, and bag dilators are very closely drawn. Theoretical considerations, while subordinated in smaller print, are not entirely eliminated, which will appeal to the advanced reader. In the discussion on the causes of internal anterior rotation, for instance, the author occupies an intermediate position between the contentions of Sellheim and of Warnekros. One may admire the book greatly without subscribing to all of the au.hor's views. One may question, for example, his advice to all gravidæ to go without their corsets and daily, after the seventh month, to knead the abdomen for a few minutes "to move the child out of a cramped position which, if too long held, may result in club foot, wry neck, etc." Or, one may object to his "prophylactic forceps" or doubt his belief in the efficacy of the so-called Prochownik diet in contracted pelvis. The final appraisal, however, will remain unaltered, that this book is a credit to American obstetrical literature.

[2] THE PRINCIPLES AND PRACTICE OF OBSTETRICS. By Joseph B. DeLee, A.M., M.D. 4th ed. Philadelphia and London: W. B. Saunders Company, 1924.

AMERICAN COLLEGE OF SURGEONS

THE STUDY OF END-RESULTS IN HOSPITALS[1]

By MABEL SEAGRAVE, M.D., Seattle, Washington
Obstetrician, General Hospital

PROPERLY to discuss end-results in obstetrics one should be able to know at the end of a year after delivery how many babies are living, how many are well developed and how many mothers are free from physical defects attributable to childbirth. Perhaps we can never hope to have a follow-up system in connection with our open staff hospital that will be entirely adequate, but I should like to see something of the sort tried. At the present time our obstetrical records at the Seattle General Hospital cover only the patient's stay at the hospital, which is usually about 2 weeks.

For the past 4 years we have been attempting to standardize our hospital work. The first year we had very little co-operation from the rank and file of doctors, but each year there has been less trouble in getting records made out, until now I may say that doctors patronizing the Seattle General Hospital have come to recognize their responsibility toward record keeping and are cheerfully co-operating with those in charge of the charts.

The result of our reviewing each month the work of the obstetrical department has been to show us that we were having too many cases of an operative nature and too many cases which were running elevated temperatures. We assumed that the technique on the obstetrical floor was probably at fault for the morbidity. We made a most careful study of the technique in the delivery room and the subsequent nursing care. We were fortunate in having for a short time as charge nurse, a woman who had trained under Dr. De Lee, and later another who took her training at Sloan Maternity. For the past 2 years we have had one of our own graduates who is full of enthusiasm toward her work.

When we felt that no further criticism could be lodged against the floor nursing technique we turned our attention to the doctors. We were amazed to find two men making vaginal examinations with ungloved hands. We found vaginal rather than rectal examinations were the rule. At our staff meetings we presented our findings. We have been fortunate in having well trained men as internes and when these young men recorded progress by rectal examinations, I think some of our older men were a little ashamed to be dependent solely upon vaginal examinations.

At the present time no vaginal examinations are made outside of the delivery room, and there only after the complete preparation of the patient and the regular 10 minute preparation of hands of the attending. No interne makes vaginal examinations.

There is much room for improvement in our work but we feel that we have progressed.

TABLE I.—SEATTLE GENERAL HOSPITAL, OBSTETRICAL DEPARTMENT

	1922–23		1923–24		Polak		Johnston and Sidall	
		Per cent		Per cent		Per cent		Per cent
Cases	442		434		1000		1059	
Forceps	83	18.7	64	14.7	22	2.2		
Cæsareans	12	2.7	5	1.15	8	.8		
Versions	4	.9	2	.46	5	.5		
Episiotomies	46	10.4	58	13.3				
Morbidity	110	24.8	97	22.3				
Revised			37	8.52	59	5.9	225	21.2

Table I gives the report of the obstetrical work done over a two year period. Statistics for each year are given separately so that the work of the two periods may be compared. This past year we have applied forceps 64 times as against 83 times last year, which is a reduction of 21 per cent. We reduced also our incidence of cæsarean operations 50 per cent and our versions 50 per cent. Unfortunately the number of episiotomies increased nearly 27 per cent. We have reduced our morbidity 10 per cent.

It may seem that our morbidity figures are very high. We have reported every temperature

[1] Read at the Washington, Oregon, British Columbia Sectional Meeting of the American College of Surgeons at Everett, August 12, 1924.

of 100.4 degrees or above. If, as many do, we do not count the cases of less than 24 hours' elevation and also eliminate systemic infections not associated with the generative tract, our morbidity would drop from 22.3 per cent to 8.52 per cent for the last 12 months. This would be lower than the morbidity of 21.2 per cent reported by Johnston and Sidall for Johns Hopkins for the years 1918, 1919 and 1920.

Polak reports a morbidity of 5.9 per cent in his last 1,000 cases but he uses 101 degrees F. temperature for the dividing line, so our figures are not comparable. However, we can well afford to meditate on the small number of his forceps cases. I think there can be no question that we have a great many more instrument cases than we should have.

TABLE II.—FORCEPS CASES, 1923–24

Type	No.	Indications		Lacerations
High	4	Maternal exhaustion	1	None 1
		Pelvic contraction	1	1st degree 0
		Mitral stenosis	1	2nd degree 3
		Hydramnios	1	3rd degree 0
Mid	25	Uterine inertia	8	None 3 1st degree 5 2nd degree 13 3rd degree 4
		Posterior position	8	
		After-coming head	1	
		Poor condition of child	2	
		Face presentation	1	
		Flattened pelvis	1	
		Large head	1	
		No progress with good pains	3	
Low	35	No progress	5	None 3 1st degree 8 2nd degree 24 3rd degree 0
		Uterine inertia	14	
		Mitral insufficiency	1	
		Contracted pelvis outlet	4	
		Posterior position	6	
		Maternal exhaustion	2	
		Maternal tuberculosis	1	
		Irregular fetal heart	1	
		After-coming head	1	

Table II gives a summary of the type of forceps and the indications given for their use in the past year's work. Probably no one could criticise very severely the reasons given for employing forceps, but one must remember that to a nervous, impatient, oversympathetic doctor uterine inertia is a frequent condition, whereas to a phlegmatic type it is quite rare. The large number of second degree lacerations noted are due for the most part to the episiotomies performed.

TABLE III.—A STUDY OF FORCEPS CASES 1923–24

	Cases in hospital	Forceps	Per cent
Doctor A	12	7	58.3
Doctor B	25	7	28
Doctor C	22	11	50
Doctor D	59	10	16.9
All others	316	29	9.17

Table III shows a rather interesting fact. Four doctors applied over 50 per cent of all the forceps, although there are about 75 men bringing obstetrical cases to the hospital. This table shows the number of cases that each of these four men brought to the hospital and the percentage of forceps cases in their respective practice at the hospital. With this group of rather radical men eliminated the percentage for the rest of the doctors falls to 9.17 per cent.

TABLE IV.—MORBIDITY, 434 CASES, 1923–24

All Temperature over 100.4				
n first 24 hours	Duration less than 24 hours		Duration more than 24 hours	
11 cases	41 cases		46 cases	
Etiology	Etiology		Etiology	
Normal Reaction (?)	Unknown	10	Unknown	6
	Intestinal absorption	6	Engorged breasts	3
	Bronchitis	1	Retained lochia	5
	Absorption of blood	1	Subinvolution	2
	Excitement	2	Perineal wound infection	4
	Engorged breasts	13	Postpartum hæmorrhage, uterus packed	1
	Retained lochia	5	Mastitis	2
	Cracked nipples	1	Retained membranes	2
	Phlebitis	1	Septicæmia	3
	Cæsarean	1	Respiratory infection	8
			Phlebitis	3
			Cæsarean section	2
			Toxæmia of pregnancy	1
			Sponge left in vagina	2
			Gangrenous appendix	1
			Pyelitis	1

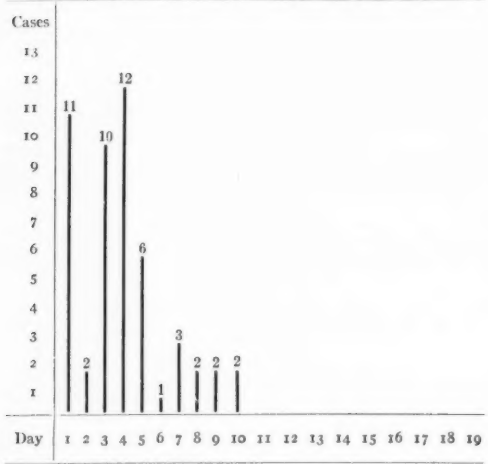
Table IV is a further study of our morbidity. Once more I want to say that we have reported here every case where the temperature has reached 100.4 degrees. We have taken this arbitrary temperature because it is used largely in Europe and in several large clinics in this country. Dr. De Lee thinks that any elevation above 98.6 degrees should be called morbidity. It would facilitate comparison of statistics if we used the same standard. I also feel that we should present all elevations of temperature and then eliminate such as are not due to puerperal sepsis.

In accordance with the custom not to count elevations on the day of delivery and no elevation unless it lasts longer than 24 hours, we can eliminate all temperatures in columns 1 and 2. In column 3 we can eliminate 8 respiratory infections and 1 gangrenous appendix. This would leave our morbidity 37, or 8.5 per cent.

Table V is a study of the elevations of temperature which are of less than 24 hours' duration. The large number of cases which have their elevation on the day of delivery and the third, fourth, and fifth day with no subsequent evidence of infection would seem to call for some physiological explanation. We accept "normal postpartum

TABLE V.—TEMPERATURE INCIDENCE

In 51 cases of less than 24 hours' elevation.



reaction" as an explanation for the elevation within 24 hours of delivery. We are not surprised even when our Staff resorts to that old taboo "engorged breasts" to explain this sudden rise and fall of temperature on the second or third day after labor.

If we did not record all elevations of temperature we would not be aware of the clinical facts brought out by this chart.

TABLE VI.—MORTALITY

Date	No. of cases	Maternal deaths	Infant deaths	Stillborn
1922–1923	442	0	10	10
1923–1924	434	1	6	19
Total	876	1	16	29
Percentage		0.11	1.8	3.3

Table VI gives our mortality record. In 2 years we have had one maternal death. This woman, who died of sepsis, had been in labor 3 days before a physician was called. Her husband and a chiropractor had attempted to deliver her. The baby was presenting by the shoulder with an arm in the vagina.

Our infant mortality was 1.8 per cent and the percentage of stillborn was 3.3 per cent for the 2 years.

TABLE VII.—MORTALITY, 1923–24

Deaths	No.	Cause
Maternal	1	Puerperal infection. Husband attempted delivery.
Infant	6	4 Premature—6 to 7 months. 1 Encephalocele. 1 Monstrosity.
Stillborn	19	6 Macerated. 5 Premature. 1 Craniotomy, advanced ossification. 2 Placenta prævia. 1 Breech, cause unknown. 1 Prolapsed cord. 1 8½ Months—cause unknown. 2 Twins—hydramnios.

Table VII is a more detailed review of the mortality for the last 12 months. For the six infant deaths there seems to be no blame to be attached to us. But among the 19 stillbirths we probably can be held responsible for several. Subtracting the macerated fetuses and the premature births we have eight infants for whom our lack of skill is probably more or less responsible for their stillbirths.

In closing I want to reiterate that I think our records show that we are doing better work. The publication of our records, and the inevitable comments of our colleagues, will no doubt stimulate us to further improvement.

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CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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THE 1925 CLINICAL CONGRESS IN PHILADELPHIA

THE Fifteenth Annual Clinical Congress of the American College of Surgeons will be held in Philadelphia October 26th to 30th, 1925, inclusive. This will be the fourth session of the Congress held in that city, previous meetings having been held there in 1911, 1916, and 1921. Fellows who attended previous sessions in Philadelphia will recall with great pleasure the highly interesting clinical programs provided by the surgeons of that city and will welcome the opportunity again to visit those clinics.

At this time the Committee on Arrangements, under the leadership of Dr. Charles F. Nassau, chairman, and Dr. Warren B. Davis, secretary, is engaged in preparing the clinical program, and it is expected that a preliminary program will be ready for publication in the next issue of this journal. All departments in surgery will be represented therein, general surgery, gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth. An important feature of the program will consist of a series of clinical demonstrations, or dry clinics, at several of the large hospitals in which surgeons, internists, pathologists, roentgenologists, and other specialists will participate to discuss some of the more important surgical subjects, thus bringing to bear on such subjects the best and most recent thought developed in the several departments of medicine.

General headquarters for the Congress will be established at the Bellevue-Stratford Hotel, corner of Broad and Walnut Streets, where the entire first floor including the Ballroom, Clover Room, Rose Room, Gold Room and other large rooms and foyers have been reserved for the exclusive use of the Congress. These rooms will be utilized for evening meetings, business sessions,

registration and ticket bureaus, bulletin rooms, executive offices, etc.

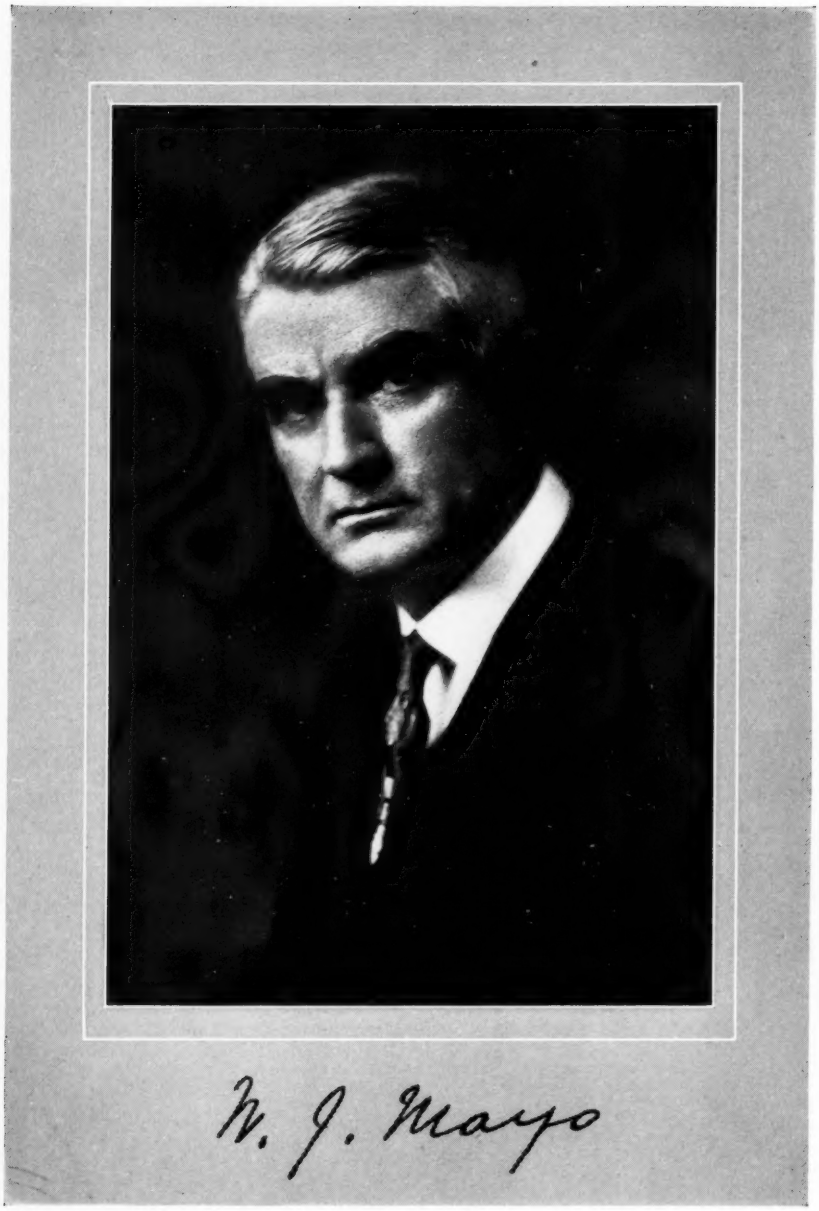
The morning and afternoon hours of Monday and Tuesday have been set apart for the annual conference on the hospital standardization program of the College and the problems related thereto. The programs for these sessions, to be published shortly, will outline an interesting series of papers and discussions of matters related to the conduct of hospitals, to be presented by surgeons, superintendents, nurses, trustees, and others.

At the Presidential meeting, to be held in the Ballroom on Monday evening, the President-Elect, Dr. Rudolph Matas of New Orleans, will be inaugurated and deliver the annual address. On Friday evening, the Thirteenth Convocation of the College will be held in the same room.

The Executive Committee of the Congress is preparing programs for the scientific meetings to be held in the Ballroom on Tuesday, Wednesday, and Thursday evenings at which papers dealing with surgical subjects of present day importance will be discussed by eminent surgeons of the United States and Canada and distinguished visitors from abroad. On two of these evenings there will be special sessions when the programs will include papers on subjects of interest to those engaged in the practice of surgery of the eye, ear, nose, and throat.

Because of the increasing interest in these annual clinical meetings, it will be necessary to enforce strictly the rule limiting attendance to a number that can be comfortably accommodated at the clinics. The limit of attendance will be based upon the result of a survey of the amphitheaters, lecture rooms, and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. This plan necessitates registration in advance on the part of all who wish to attend the Congress. When the limit of attendance has been reached through advance registration, no further applications can be accepted. To provide for the distribution of visiting surgeons among the several clinics and to insure against overcrowding, attendance at clinics and demonstrations will be controlled by means of special tickets, the number of tickets issued for any clinic being limited to the capacity of the room in which that clinic is given.

The hotel situation in Philadelphia has been much improved since the last meeting in 1921 by the erection of a number of fine large hotels situated within easy walking distance of the Bellevue-Stratford so that ample accommodations at reasonable rates will be available.



W. J. Mayo

TWENTY YEARS OF SURGERY

SURGERY, GYNECOLOGY AND OBSTETRICS TWENTY YEARS OLD

THE first copy of SURGERY, GYNECOLOGY AND OBSTETRICS was issued July 1, 1905. In an editorial announcement printed in the initial number were the following words:

"SURGERY, GYNECOLOGY AND OBSTETRICS has been evolved in the minds of its organizers from a feeling that the field of the three allied specialties represented by its title is not overcultivated, and that there is already a place for a creditable magazine representing in one publication these three divisions of surgery.

"It was also conceived that specialists, for whose success is required the highest adaptability for their calling combined with the cultivation of technique, the scientific spirit, and the highest industry and experience, should have a direct supervision of the contributions to the literature pertaining to their own work. Hence practical surgeons, gynecologists, and obstetricians will direct editorially the trend of policy of SURGERY, GYNECOLOGY AND OBSTETRICS.

"It was also conceived that a living journal should be a leader to the thought for which it stands, not alone a depository for established facts; that its editors should be in position to discern and to bring forth the truths of thought of men of tomorrow rather than to patronize reputations of yesterday at the expense of valuable new material; that practical men dealing with facts and actually engaged in the work of the day, are best fitted to discern the signs of the future and to supervise and direct the course of its literature.

"We believe that the best medical journals should be controlled financially by those who are interested in their literary development. We also believe that ultimately this need not involve financial loss. . . .

"The editorial staff of SURGERY, GYNECOLOGY AND OBSTETRICS feels deeply that there is a future for this kind of publication, and not one of its members will be satisfied if the journal does not take immediately a prominent place in the world of medical journalism and ultimately a leading position. . . ."

These words of that editorial, confidently written twenty years ago by the inexperienced but hopeful editorial staff of SURGERY, GYNECOLOGY AND OBSTETRICS, have become a prophecy. From the beginning its editors have exerted every legitimate effort so that the publication might continue to meet the approval of practical scientific surgeons. In 1913 there was organized and added to its pages

the INTERNATIONAL ABSTRACT OF SURGERY. Each year from the time of the initial publication the scope of the journal has been amplified and its material strengthened. In its original article department, in its editorial department, in its abstract department, and in its departments of technique and book reviews, we have sought to make it a magazine that would satisfy all specialists of the science and art of surgery.

Judging from its support, in numbers and in class, the editors have every reason to believe that their efforts have been appreciated by the discriminating readers of the best surgical literature, and that the policy announced at the beginning of its publication is a sound one, and if efficiently pursued will warrant the continued approval and support of the practitioners of creditable surgery.

The success of the journal has been due in great measure to the active support which has been accorded the editors by the leaders of the medical profession. Space does not permit mention by name of all the men who have given generously of their time and inspiration. It is a great pleasure, however, to present in this issue portraits of the three men who have been the chiefs of the Editorial Board throughout the twenty years: Nicholas Senn, 1905 to 1908; John B. Murphy, 1908 to 1916; and William J. Mayo, for the American College of Surgeons, 1916 to the present time.

FRANKLIN H. MARTIN.

PROGRESS OF SURGERY IN THE LAST TWO DECADES

WITH the present issue, SURGERY, GYNECOLOGY AND OBSTETRICS completes the twentieth year of its existence. The achievement of two decades must well repay the sacrifice and devotion of its Founder, Dr. Franklin H. Martin. It was a fine thing for a surgeon in active and successful practice to devote his time and energy to the promotion of another journal in the field which had been so ably covered by the *Annals of Surgery*. Today America has 120,000,000 people, yet even twenty years ago, with 90,000,000 people, it needed another organ for the expression of a growing surgical profession. Rightly the attempt of the editor of SURGERY, GYNECOLOGY AND OBSTETRICS from its inception was to make the journal an adjunct to, rather than a competitor of, the *Annals*.

Twenty fruitful years have made a great change in surgery. The pathology of the dead house which made so excellent a foundation has been supplemented by what Moynihan has so aptly termed "the pathology of the living." Asepsis has replaced antisepsis. Local anæsthesia has come into its own. Ethylene, with or without ether, has added to the merits of general anæsthesia safety and greater freedom from pulmonary complications. More careful preparation of patients for operation, made possible by precise studies of the blood, has reduced mortality and brought relief to those apparently beyond aid.

The tide of specialization, made necessary by extraordinary additions to knowledge beyond the possibility of any one man's grasp, has brought a co-operative spirit into medical practice. One can trace through the development of specialization, like the theme of a melody, the consistent purpose of carrying the benefits of modern medicine to the sick.

One must admire the pioneers whose exploratory operations on the brain and spinal cord established the frontiers of neurologic surgery and made a firm foundation for further advancement. Attention first concentrated on how best to open the calvaria is now focused on what should be done after it is opened. The sufferers who formerly endured the agony of the various tics can now be safely relieved, and many patients with tumors of the brain and spinal cord of a type once considered hopeless, are enabled to return to a useful life instead of continuing to chronic invalidism, blindness, paralysis, and death.

Great advances have been made in those sciences which protect the blessed sense of sight. The glaucomata are no longer allowed, "like thieves in the night," to steal away the power of vision.

Every human being has the divine right to look human. One of the compensations of the Great War was the development of plastic surgery of the face, a new special field in surgery which has given astonishing results.

A sound understanding of diseases of the thyroid has been almost entirely a development of the last decade. The chemist, the research worker, the internist, and the surgeon have organized and combined to bring about the safety with which the patients with exophthalmic and toxic goiters are now restored to health by surgical means.

Thoracic surgery owes much to the War. Bold spirits have striven mightily to relieve serious conditions of the heart and the great blood vessels, the lungs, the pleuræ, and the œsophagus, and have been rewarded by great advances in the knowledge of what can be done and a new perspective of what may be done.

In abdominal surgery, the advance has been startling. Early X-ray diagnosis and better preparation of patients for operation has greatly reduced the mortality and increased the percentage of cures of cancer of the stomach. While the surgical treatment of gastric ulcer has rightly grown more radical, that of duodenal ulcer, if anything, has become more conservative. The spleen, of unimportant function, when diseased has been found to be a serious menace to the life of the blood, and by focusing attention on certain blood dyscrasias has led to studies of fundamental importance. In surgery of the gall bladder, cholecystectomy has gradually replaced cholecystostomy when the disease is confined to the gall bladder, although cholecystostomy remains the operation of choice when complications exist in the large bile ducts and the pancreas. Cancer of the large intestine and rectum has received much attention, and radical operations in this unpromising field of surgery have given a percentage of cures greater in this region than in any other organ in the body except the fundus uteri.

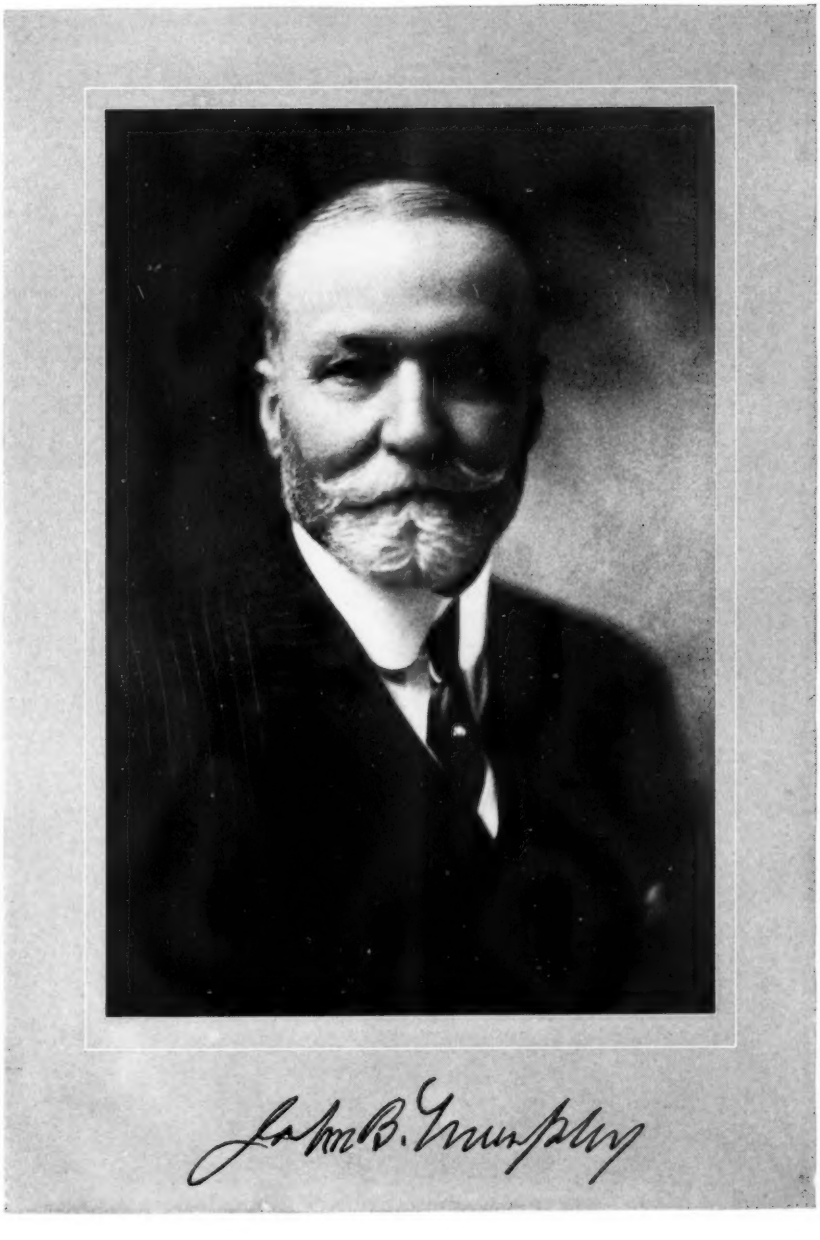
Gynecologists have become more conservative. There is less ovarian and uterine tinkering, and a brilliant body of surgeons has added abdominal surgery to its repertoire. Obstetrics and the surgical care of obstetrical injuries, a fundamental branch of surgery, previously lost in gynecology, today forms a splendid specialty which is conferring new blessings on womankind.

The urologists, with the accurate diagnostic and therapeutic measures which they now possess, have brought certainty into the surgical treatment of urogenital conditions, and, thanks to them, the treatment of neurasthenia by nephrorraphy is a thing of the past.

Orthopedic surgery has passed from the stage of harness-making to the application of well thought-out surgical principles, a school of teaching of which Sir Robert Jones, of Liverpool, and the late, lamented Robert Lovett, of Boston, were the leading spirits.

Of the many newer additions which have come to the aid of surgeons, radiotherapy is the most important. Through the sound efforts of talented workers, these valuable agents have passed beyond the stage of exploitation.

The greatest event in the history of American surgery was the formation, in 1913, of the American College of Surgeons, due to the vision and courage of Dr.



John B. Grumpley

Franklin H. Martin. This organization has raised the surgical standards of medical education. It has rightly focused attention on the fact that the mere possession of a diploma to practice medicine does not make its possessor a specialist in all branches, and that while experience is necessary in the making of a good surgeon, ways and means of gaining this experience must be provided which are not at the expense of the unfortunate patient. The College justly insists not only on a grade of excellence in surgery which can be gained only by serious graduate study, but also on observance of the tenet that the ethics of the surgeon shall be above reproach. In no way has the influence of the College been felt to greater advantage than in the standardization of hospitals, which has changed hundreds of boarding houses for the sick into hospitals in the truest sense of the word, which compare favorably with similar institutions anywhere in the world. The American College of Surgeons has taken its place as one of the most beneficent of American institutions.

We may well look back with pride and satisfaction on the advances which have been made within the lifetime of the journal, SURGERY, GYNECOLOGY AND OBSTETRICS, with fuller appreciation of what this adventure in surgical journalism has done to forward the making of surgical history.

WILLIAM J. MAYO.

TWENTY YEARS OF SURGERY AND AN INDEX

WITHIN the next few months SURGERY, GYNECOLOGY AND OBSTETRICS will present to its readers an index of volumes i–xl. To those long familiar with the journal the value and importance of such a volume will be obvious. For those whose acquaintance has been of shorter duration it may not be amiss to recall the purpose of its editors, as declared in the first number, and some of the outstanding events of its past history, in order that the significance of an index volume may be appreciated.

On the editorial page of the first number of volume i, dated July, 1905, appears the following: "They (the editors) realize that there is no call for another ordinary surgical journal, and that if they do not succeed in making this a journal far beyond the ordinary there is no reason for its existence." As to the measure of their success in carrying out this expressed purpose the index volume is the best indication.

The list of contributors to the first number is of interest: Nicholas Senn, of Chicago; E. E. Montgomery, of Philadelphia; Weller Van Hook, of Chicago; Eugene Boise, of Grand Rapids; J. Clarence Webster, of Chicago; Edward P. Davis, of Philadelphia; J. Whitridge Williams, of Baltimore; J. Clifton Edgar, of New York; Henry C. Coe, of New York; and Henry D. Fry, of Washington, D. C., three of them specialists in surgery, four in gynecology, three in obstetrics,—a notable company. The first article was by Nicholas Senn on "Iodine in Surgery, with Special Reference to Its Use as an Antiseptic," one of the best known and widely commented upon of his many contributions to surgical literature.

In later numbers of volume i appeared Tuffier's paper on conservation of the ovaries and uterus in operative procedures upon the uterine adnexa, Kanavel's first contribution on the pathology and treatment of hand infections, Cushing's proposal to establish cerebral hernia as a decompressive measure in the treatment of inaccessible brain tumors, and Yates' experimental study of the local effects of peritoneal drainage, in which he showed conclusively the futility of attempting to drain the general peritoneal cavity.

In the first numbers of volume ii appeared papers by Mayo-Robson, Lexer, and Duehrssen, three of the most eminent of European medical men. In the same volume appeared a discussion of the treatment of fractures of the femur by Davison, with illustrations showing the use of the Balkan frame for balanced suspension of the lower extremity. A contribution by Carrel on blood vessel surgery, another by Brewer on septic infarcts of the kidney, a third by Blake on the use of magnesium sulphate as an anæsthetic and in the treatment of tetanus, and a fourth by Watkins on the treatment of cystocele and prolapse, are a few of many important papers which appeared in the second volume.

In volume iii appeared Crile and Dolley's clinical and experimental observations on surgical hæmorrhage, a symposium on surgery of the large intestine, with particular reference to cancer of the sigmoid and rectum, by C. H. Mayo, George E. Armstrong, and Joseph C. Bloodgood, and a contribution by Senn on "Tendon Tissue versus Catgut Ligatures," in which he said: "The surgeon who relies on the metallic suture—gold, silver, or bronze aluminum wire—in holding living tissues in permanent apposition will sooner or later learn that nature does not tolerate such interference for any length of time. The employment of metallic sutures will at no distant time be limited to the suturing of bone."

In 1907, Wertheim was invited by the editors of SURGERY, GYNECOLOGY AND OBSTETRICS to visit America and address the Chicago Gynecological Society. His address on "Radical Abdominal Operation in Carcinoma of the Cervix Uteri" appears in volume iv. In the same volume appeared John B. Murphy's comprehensive discussion of neurological surgery and Watkins' paper on the non-operative treatment of pelvic infections.

In volume v appeared W. J. Mayo's important contribution on acquired diverticulitis of the large intestine, C. H. Mayo's description of the treatment of the posterior capsule of the thyroid gland based on 375 operations, and a symposium on the end-results of the treatment of carcinoma of the breast by Vander Veer of New York, Greenough, Simmons, and Barney of the Massachusetts General Hospital, Jonas of Omaha, Willy Meyer and Dennis of New York.

In January, 1908, the names of A. W. Mayo-Robson, B. G. A. Moynihan, John Bland-Sutton, John Stephen McArdle, Harold J. Stiles, and James Rutherford Morison were added to the editorial staff and the publication of a separate edition for the British Empire was begun. In the January number of 1908 were contributions from three of Great Britain's foremost surgeons—Bland-Sutton, Moynihan, and Mayo-Robson. The latter in writing on interstitial pancreatitis in its relation to catarrhal jaundice called attention to the frequent association of pancreatitis with inflammatory disease of the bile passages, and the importance of conserving the gall bladder in order to secure adequate drainage of the liver and of the bile passages—observations which after 17 years are still of basic and primary importance.

In the same volume were papers by Deaver on the medical and surgical treatment of gall stones, by Connell on peptic ulcer of the jejunum, by Coley on bone sarcoma, by Lane on chronic constipation, by Cushing on the technique of cranial operations, by Reverdin on the intraglandular enucleation of thyroid adenomata, by Murphy on perforative peritonitis, by Rodman on the development of gastric cancer subsequent to ulcer, and by Coffey on the principles involved in the treatment of retrodisplacements of the uterus.

Space does not permit us to review in detail succeeding volumes. Friedrich's

operation for unilateral tuberculosis (total mobilization of the chest wall), C. H. Mayo's report of the results in 1,000 operations for goiter (March, 1909), Brewer and Liggett's account of the direct transfusion of blood with paraffin-coated glass tubes (September, 1909), Frazier's results in the treatment of spasticity by resection of the posterior roots of the spinal cord (September, 1910), Quinby's experimental work on intratracheal insufflation (November, 1910), Crile's enunciation of "Anoci-association—a New Principle in Operative Surgery" (August, 1911) are only a few of the many important contributions appearing during the first five years of publication of the Journal.

In the forty volumes which are brought to a conclusion with the present number upward of five thousand original contributions have appeared. They represent the growth and progress of twenty years. Many of them were the source and inspiration of growth. These contributions have not been confined to one phase or department of medicine—they have represented faithfully and impartially the three great branches of medicine which were chosen as the name of the Journal. They have included both reports of experimental work that pointed the way to progress in surgical practice, and reports of attained results that rendered more universal and more sure the application of well-tried principles. To recite the list of authors is to call the roll of eminent workers in the field of surgery, of gynecology, and of obstetrics not only in the Americas, but in Great Britain, on the Continent, and in more distant quarters of the globe. It is the belief of the editors that the publication of the index volume will make more readily accessible and more widely appreciated this comprehensive and noteworthy addition to the world's surgical literature.

SUMNER L. KOCH.

Nicholas Senn